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THE JOHN HUNTER MEMORIAL SERVICE

ST. MARTIN'S-IN-THE-FIELDS, THURSDAY, FEB. 14, 1952, AT 11 A.M.

THE SERMON

GIVEN BY

SIR GORDON GORDON-TAYLOR, K.B.E., C.B., F.R.C.S.

WE are met this day, John Hunter's birthday, to dedicate within this ancient church a plaque which not only recalls an incident, but commemorates the lives of service of two men of our profession who expended their insatiable energies in the endeavour to read aright and decipher the secrets of Nature, and in their divers ways to aid humanity.

Although very sensible of the honour bestowed on me by the President and Council of the Royal College of Surgeons of England, who have charged me with the duty of addressing those present here this morning, I am none the less deeply conscious of my own shortcomings as a speaker on such an occasion and am reminded, to my discomfiture, of those words employed by Goethe: "To feel and respect a great personality one must be something one self."

A brief account of the circumstances attending the discovery of John Hunter's remains in the crypt under this church, their removal to Westminster Abbey and re-interment in that Valhalla of kings and heroes and the great names of our land, is not inappropriate to the occasion. After the delivery of the Hunterian Oration by Joseph Henry Green in 1847, and at the customary dinner following, the Rev. Dr. William Buckland, Dean of Westminster, and father of Frank Buckland, said that he had already expressed regret to Richard Owen, then Conservator of the Hunterian Museum, that the medical profession had erected no monument to the memory of Hunter, and that he had himself suggested the propriety of one being placed in a vacant niche in the Abbey. Nine years later, at a centenary dinner at St. George's in October, 1856, commemorating the studentship of Hunter at that Hospital, Frank Buckland, himself a 'St. George's man', made a mental resolve to do honour one day to the remains of the surgical hero whom he so greatly venerated. Only two years had elapsed before Buckland, at that

ERECTED BY
THE ROYAL COLLEGE OF SURGEONS OF ENGLAND
TO RECORD THAT THERE RESTED IN THESE VAULTS
FROM 1793 TO 1859 THE BODY OF
JOHN HUNTER
FOUNDER OF SCIENTIFIC SURGERY
AFTER LONG AND DILIGENT SEARCH INITIATED
AND CARRIED OUT BY FRANK BUCKLAND A MEMBER
OF THE COLLEGE THE REMAINS WERE IDENTIFIED
AND TRANSFERRED TO WESTMINSTER ABBEY

Sir Henry Dale, who unveiled the Plaque, with the President of the Royal College of Surgeons, Sir Cecil Wakeley.

time Assistant Surgeon to the 2nd Life Guards, one January morning in 1859 in the Mess Room of the Barracks at Windsor chanced to read the notice of an Order in Council requiring the vaults of St. Martin's to be cleared of the coffins which they contained. Suddenly he bethought himself that John Hunter's remains surely lay there. His leave of absence from his regimental duties most opportunely occurred at this very time. An appeal to Queckett, who had succeeded Owen as Conservator in Lincoln's Inn Fields, and to Palmer's *Life of Hunter* confirmed Buckland's belief that Hunter was buried in St. Martin's, and on Jan. 26, 1859, he found there the registry of Hunter's death.

This is not the occasion or the place to describe in the manner of Grand Guignol the macabre task which Buckland with praiseworthy devotion brought to a successful conclusion. It suffices to say that in clearing out the charnel house underneath this church 3260 coffins were removed and inspected, and that of Hunter was the second last to be exposed to view. No silence like that of Cortes on a peak in Darien greeted the discovery, and the Vicar of those days hastened to the shouts of exultation which issued from the crypt. Buckland had hoped to have found the coffin before the delivery of that year's Hunterian Oration by John Bishop on Hunter's birthday, Feb. 14, but by now it was Feb. 22. The remains had lain there for 66 years, since 1793. Hastily Buckland rushed with the news to Arnott, one of the Vice-Presidents, and to Queckett, who both came along ; and the next day Mr. J. F. South, the Junior Vice-President, Mr. James, his assistant, and Professor Owen arrived to view the coffin. On March 26 the coffin was removed to the Abbey, and re-interred on March 28 between the resting places of Ben Jonson and Sir Charles Lyell in front of a crowd of 600 persons.

What of these Victorian days ? Queen Victoria's Prince Consort was still alive ; the Indian Mutiny had been quelled two years before ; the campaign in Oude had come to a successful termination and Oude had just been annexed. The Piedmontese statesman, Cavour, was in the saddle in Italy, and the campaign against Austria had not yet come to its close. A few days before the Abbey ceremony there had been a wreck of a cross-Channel steamer, with loss of life, and Thomas Carlyle, the ' Chelsea seer ', had declined nomination as Rector of Aberdeen University, although he accepted Edinburgh University a few years after !

With Chauvinistic zeal a St. George's alumnus had rendered a devoted tribute to the illustrious St. George's surgeon. There is this strange coincidence that at the ceremony at the Abbey ninety-three years ago the President and one of the Vice-Presidents of the College of Surgeons were or had been Professors of Surgery at King's College, London, while Sir William Fergusson, the distinguished surgeon to that Hospital, a future President though not yet on the Council of the College of Surgeons, was also present in the Abbey ; to-day this ceremony takes place during the Presidency of another renowned King's College Surgeon. The accidental association of King's College and St. George's that March day in 1859 is replaced by a more lasting linkage at this present time.

To-day we also commemorate the lives of service of two great men. It would be beyond my powers successfully to recall before this audience, if only for a brief space of time, the great surgical Shade so intimately associated with our College, or to endeavour anew to invest a great legendary name with some panoply of his vital attributes. Since 1813, when the endowment of a Hunterian Oration was accepted under a Deed of Trust from John Hunter's executors, Dr. Matthew Baillie and Sir Everard Home, by the Royal College of Surgeons of England, eighty-four Orations have been delivered at the College by Hunterian Orators, nor has the Hunterian Society proved unworthy of the eponymous title which it enjoys. The tradition of the Hunterian Museum has exercised a profound influence on the development of surgery throughout the years ; with illustrious Conservators like Clift, Owen, Flower, and the evergreen Arthur Keith, the Collection in Lincoln's Inn Fields had been, till the holocaust of 1941, a Mecca for surgeons from all over the world. Happily under the ægis of Geoffrey Hadfield and of Frederic Wood-Jones, one of the proudest names in the long saga of custodians, the Museum, like another Phœnix, is already rising from the ashes. In the creation of Hunter's own Museum there was evident giant energy and resolution directed by a correspondingly clear and ample idea ; here was no mere miscellaneous assemblage of odds and ends as were so many collections of Hunter's contemporaries and predecessors, but an arrangement of orderly series illustrating the living world and the processes of disease. Yet the critical mind of Wilfred Trotter wondered whether even the richness and order of this historic monument, the very " focus and palladium " of the College of Surgeons, could have invested its creator with his " unique and enduring prestige ".

Frank Buckland in his own private journal refers to a Hunterian Lecture by Sir Charles Bell in reference to Hunter's genius. " The great leading feature in him was that he was steadily and eagerly devoted to his object, and that no change of circumstances had the power for one moment of turning him aside from it. Was he in his study or dissecting room, or mingling with all in the common occupations of life, was he at sea, shut up in a crowded transport, or was he on the field of battle, his great object was steadily and habitually before him, and he never lost an opportunity of seizing upon everything that could in any way be made to bear upon it." This included the experimental method, and Hunter consistently employed this in the study of living processes, and on this his fame essentially and ultimately rests. It was by impressing this method on his pupils and successors that his services to science and surgery have had their richest and most extended effects.

The words written by J. F. South, and contained in the ornamental brass which covers Hunter's remains in the Abbey, doubtless mirrored the views of surgeons nearly seventy years after his death— " to record their admiration of his genius as a gifted interpreter of the Divine Power and Wisdom at work in the Laws of Organic Life, and their grateful veneration for his services to Mankind as the Founder of Scientific Surgery ". To this day we

salute " one who was great through mortal days and died of fame unshorn ".

Frank Buckland was born of and cradled in science ; he formed the nucleus of his own museum at four years of age, and at seven he commenced a daily journal which he meticulously kept all his life ; from his earliest years training made him a keen and observant naturalist. For him the Terentian formula embraced the animal kingdom as well as mankind, and from Oxford undergraduate days till death he lived on intimate terms with primates, parrots, and porpoises, marmots and mice, a bear and a jaguar, snakes, skeletons, and salmon spawn. His interest in the acclimatization of animals led to strange exploratory feasts of bison and kangaroo, horse flesh or roast giraffe, and he endeavoured to popularize whale meat a century before necessity compelled a reluctant nation.

It is well over sixty years since I read with avidity his *Curiosities of Natural History*, which with a filial piety he dedicated to his beloved parents. The successive deaths of his father and mother, his failure to obtain the full surgeoncy to his regiment, and his subsequent resignation from the Army, as well as his severance from *The Field* to which he had been a most important contributor for many years, all constituted a crisis in Frank Buckland's biphasic life story. Henceforth the somewhat erratic surgeon-anatomist disappears from the picture, and the true Frank Buckland of fishery fame emerges. He developed a strong bias for turning to practical use the facts of natural history that he ascertained, and it was this that prompted him to take up fish culture ; the idea of ' farming the sea ', as agriculturists farm the land, took early hold of his practical imagination. In 1880, only two days before his death, he wrote : " How are we to devise a mesh of net that shall let go the small soles and undersized fry of other fish, keeping the marketable fish only, allowing the others to escape and grow ? " The unsupported dream of a practical visionary has now come true.

His fishery museum, which he left to the Science Museum, South Kensington, was largely destroyed in the ' blitz '. By gathering together and summarizing knowledge, especially recently acquired knowledge relating to important food fishes, and presenting this in a useful form for those engaged in fishery research, the Buckland Research Foundation makes an important contribution to current fishery work. The first course of lectures under the Buckland Foundation were the 1929 Buckland Lectures by Professor W. Garstang on ' Fish Farming ', a subject dear to Buckland's heart, and the ' Balance of Life in the Sea '. I have also enjoyed the opportunity of reading the Buckland Lectures by W. H. Calderwood (1930) and W. J. M. Menzies (1939) on the salmon, by W. C. Hodgson on the herring (1933), by J. H. Orton on the oyster (1935), and by Michael Graham on the cod (1939). The wonderful story of the sea with its fauna and flora told by the various Buckland Lecturers brings the words to one's lips : " He being dead yet speaketh ".

It is impossible on this occasion to do more than refer in the briefest fashion to a very few of the more recent advances in our knowledge of the food fishes and fisheries. Much of the life history of the oyster has been learned since the day of Frank Buckland, who himself did much to put our shell fisheries on a sound and hygienic footing ; there is now scientific proof that sex change in the oyster from female to male and from male to female occurs, and just as Adam had priority at the beginning, so the baby oyster probably always develops first into a male ; the female phase divine is assumed more rapidly in France than in England, where young oysters do not usually produce their first batch of eggs till their third or fourth summer. The mechanism of feeding in the oyster reads like a fairy tale. The old story of Pliny that oysters increase in size with the waxing of the moon has been exploded, while spawning is definitely related to temperature variations, 68° F. being the determining figure for *Ostrea edulis*.

Fifteen years were to elapse since Buckland's death before the fish-scale or the otolith came to be reckoned a reliable index for estimating the age of a fish ; Hjort, Dahl, and Einar Lea, of Bergen, found that the herring scale added one ring each year of its life ; and Lea called the scale the " herring's passport ", since from a single scale he could tell from which part of Northern European waters a herring came. Heincke, of Kiel, computed differences in the number of rays in certain fins, in the number of scales on the underside of the fish, and in the number of vertebræ in the backbone of herrings according to the part of the sea from which they had journeyed.

Had Buckland lived to-day, he would also have been aware that the otocyst (ear-bone) furnishes a valuable index of age in such demersal fish as the cod, plaice, and hake ; and he would have been amazed and delighted that a forecast for the forthcoming fishery season is now possible and that the balance of life in the sea could be expressed as an equation such as Russell's formula (C+M=A+G).

Salmon research since Buckland's time by observers such as Calderwood and Menzies in Britain, Gunnar Alm in Denmark, Dahl and his colleagues in Norway, and Huntsman in Canada has added to our knowledge of salmon migration, the ' homing instinct ' of salmon and even the rate of their travel. It is known to-day that open sea passage over relatively considerable distances, say 500–1000 miles, may reasonably be covered at the rate of 25 miles per day ; and the deduction is that the feeding grounds for the salmon of the rivers of the West of Great Britain and the North and East coast of Scotland is to the west and north-west in the Atlantic, whence they unerringly return in their shoals from an instinct and with higher hopes than the nostalgic Hebridean exile in Canada, who sang so sadly :

> From the lone shieling in the misty island
> Mountains divide us and the waste of seas,
> But hope is strong and blood is Highland
> And we in dreams behold the Hebrides.

Those that juggle with salmon eggs and smolts and rivers find that the subtlety of the fish is a match for the experimentalist. No caprice dictates the ascent of the salmon at certain times into certain tributaries of, for example, the Tay ; it is the temperature of the water which coaxes and beckons, so that the fish ascend the Lyon first, then the

Tummel, and the Garry last of all. Buckland would have rejoiced that his death had not been in vain and that the attempts to introduce the salmon into New Zealand by means of transported eggs had been at last attended by success. In view of all his 'by-passes' and ladders to help the salmon in their ascent of the rivers, he would have been intrigued to know that a jump of 11 ft. 4 in. had been noted on the river Orrin in Ross.

My duty is ended. This is no recurrent memorial ceremony, and we are therefore absolved from the imputation and charge levelled by Trotter that the stimulation and enlargement of mind afforded by commemorations are sometimes less potent than could be desired. As we offer to these great men of a previous age our laurel for tribute and rosemary for remembrance, we thank God for their lives of service, God's greatest gift to mankind, that gift which King George VI, whose death we so deeply mourn, unceasingly displayed, and of which he was such a shining exemplar. But a third name will inevitably steal into the thoughts at least of some of us, for it is due to the zeal and enthusiasm of that great surgeon George Grey Turner, alas! no longer with us, that the project to place a commemorative plaque to John Hunter within this Church was initiated and has now come to fruition. Albeit with many a difference between them, all three were great collectors and fervent believers in the value of the museum. Epictetus employed the expression τὸ ἡγεμονικόν to indicate the master quality in a man; in Hunter, Buckland, and Grey Turner τὸ ἡγεμονικόν was their incessant, insatiable industry. All three died immersed in the work which they loved, like the Venerable Bede of Jarrow Abbey long years ago.

The story of commemorative tablets stretches far back to the dark abysm of time, to the days of the first Egyptian Dynasty around 3100 B.C., when certain carved stones, each having a figure and a hieroglyph, are thought to indicate the dead man's name. Not till 2000 years later, about 1400 B.C., in the shaft graves of Mycenae, has archæological research demonstrated memorial tablets for the Hellenic dead. Desire is instinctive in mankind to escape the caverns of oblivion; Cyrus, Xerxes, and Darius, as well as Artaxerxes, charged not their seed with their commemoration, but seizing time by the forelock built themselves tombs in their lifetime, with suitable legends in their own honour. We are told that "Diaturnity is a dream and folly of expectation", and vainly may the archæologist, builder, artist, and poet engage in vexatious disputations concerning the best means of achieving immortality. Though the Pyramids and the Taj Mahal may constitute a silent record of Cheops and the Indian girl, Shakespeare knew the brevity of marbles:—

> When wasteful war shall statues overturn
> And broils root out the work of masonry,
> Nor Mars his sword nor war's quick fire shall burn
> The living record of your memory.
> 'Gainst death and all oblivious enmity
> Shall you pace forth; your praise shall still find room
> Even in the eyes of all posterity
> That wear this world out to the ending doom.

Horace put his trust in his own poetry and with prophetic assurance could write: "Non omnis moriar", and foretold for himself by his skilful felicitous pen "Monumentum aere perennius".

Catullus and Milton, Prior and Pope, secured immortality even for the unknown by means of their verse, and Tennyson's "In Memoriam" will keep the memory of Hallam evergreen. Leonardo da Vinci's artist brush rendered a similar service for Mona Lisa, and Sullivan's "Lost Chord" perpetuates a brother.

In the centuries that stretch away into the dim future, when this historic temple has mouldered in the dust and its monuments shall be no more than Shelley's Ozymandias, King of Kings, the life and work and name of those whom we commemorate to-day will endure, for is not the whole earth the tomb of great men? Recall for a moment those great lines which Thucydides, that wondrous master of Greek prose, puts in the lips of Pericles in his famous funeral oration over the Athenian dead:—

ἀνδρῶν γὰρ ἐπιφανῶν πᾶσα γῆ τάφος, καὶ οὐ στηλῶν μόνον ἐν τῇ οἰκείᾳ σημάινει ἐπιγραφή, ἀλλὰ καὶ ἐν τῇ μὴ προσηκούσῃ ἄγραφος μνήμη παρ' ἑκάστῳ τῆς γνώμης μᾶλλον ἢ τοῦ ἔργου ἐνδιαιτᾶται.*

A good life hath its number of days; but a good name continueth for ever.—ECCLESIASTICUS xli.

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* The whole earth is the tomb of great men. Neither is their name graven only on stone which covers their clay, but abideth everywhere without visible symbol wrought in the stuff of other men's lives.

THE ASSOCIATION OF CHRONIC ULCERATIVE COLITIS AND CARCINOMA OF THE RECTUM AND COLON

By P. BRIAN COUNSELL and CUTHBERT E. DUKES
FROM ST. MARK'S HOSPITAL

THE association between chronic ulcerative colitis and carcinoma of the rectum and colon is not generally recognized. Interest in this complication has been stimulated largely as a result of the observations of Bargen and his associates at the Mayo Clinic. While there have been many excellent papers on this subject from American sources in the last twenty-five years, few have appeared in British medical literature.

In this paper we shall review 13 cases of carcinoma of the large bowel complicating ulcerative colitis. Seven of these cases were patients at St. Mark's Hospital during the period of January, 1941, to June, 1951 (2 of which have previously been reported by Gabriel in 1950). During these years 63 cases of severe ulcerative colitis were treated surgically. The incidence of malignancy in the surgically treated patients was therefore 11·1 per cent. The other 6 cases studied were from other hospitals, the operation or post-mortem specimens having been examined by one of us (C. E. D.).

REVIEW OF RECORDED CASES

The first case of carcinoma complicating chronic ulcerative colitis which we have been able to trace was described by Yeomans (1927) in a paper recording 7 cases of malignant change occurring in adenomatous tumours of the colon; one of these was a woman with chronic ulcerative colitis who developed carcinoma of the rectum. In the following year Bargen (1928) described 20 cases of malignant disease of the large bowel (including 2 cases of lymphosarcoma, 1 case of lymphatic leukæmia, and 3 cases of carcinoma diagnosed on clinical and radiological evidence but without microscopical confirmation) associated with ulcerative colitis. In addition, 7 cases were described by Bargen and Dixon (1935) and a further 30 cases were recorded by Bargen and Sauer (1944). The most recent paper by Sauer and Bargen (1949) describes a further 41 cases. Thus 95 cases of carcinoma following chronic ulcerative colitis have been seen at the Mayo Clinic since 1916.

There have been many reports of small numbers of cases, usually 1 or 2. Fewer papers, however, have described more than 3 cases and given an indication of the incidence of carcinomatous change in chronic ulcerative colitis. Streicher (1938) described 3 cases of carcinoma arising in a series of 217 cases of ulcerative colitis, an incidence of only 1·4 per cent. Jackman, Bargen, and Helmholz (1940) found the incidence to be 3·2 per cent of 871 cases, but in 95 of these the colitis had started before the age of 16 years and in this subgroup the incidence was nearly twice as high—namely, 6·3 per cent. Lyon (1945) reviewed the literature of the previous ten years and found that 98 cases of carcinoma arising in chronic ulcerative colitis had been reported. Twenty-eight of these had occurred in a group of 1467 cases of ulcerative colitis, an incidence of 1·9 per cent. The other 70 cases had been reported without an indication of the incidence of carcinomatous change. Ricketts and Palmer (1946) described 3 cases of cancer among 206, an incidence of 1·4 per cent. Cattell and Boehme (1947) found an incidence of 2 per cent, there being 9 carcinomas in 450 cases. Cattell (1948) expressed the incidence as 7 per cent of the cases operated upon for ulcerative colitis. Kasich, Weingarten, and Brown (1949) found an incidence of 4·9 per cent of 143 cases of severe ulcerative colitis. Svartz and Ernberg (1949) had 9 cases, showing an overall incidence of 3·1 per cent of 290 cases. Gleckler and Brown (1950) reported 12 cases out of a series of 316, giving an incidence of 3·8 per cent. Rice-Oxley and Truelove (1950) found 4 cases in 129, giving an incidence of 3·1 per cent. Lyons and Garlock (1951) described 9 cases in 226 surgically treated cases of ulcerative colitis, giving an incidence of 3·9 per cent. Of greater significance, however, was their finding that of those cases having ulcerative colitis for twelve years or more, 36 per cent developed carcinoma.

There have been fewer series reported without carcinomatous change. Hern (1931) described 50 cases, none of which developed carcinoma. Hurst (1935) recorded a series of 40 cases. He mentioned having seen 3 cases of malignant change, though none were included in this group. Willard, Pessel, Hundley, and Bockus (1938) and Feder (1938) reported respectively 66 and 88 cases without cancer. Felsen and Wolarsky (1949) had no cases of carcinoma in 855 patients, the majority of whom had had ulcerative colitis for many years and had been repeatedly examined during this period. No mention was made regarding the number of cases treated surgically. Hardy, Brooke, and Hawkins (1949) stated that "malignant disease is in our experience a rare complication". Cattell has noted that in those series which reported no cancer the incidence of surgical intervention was very low.

CLINICAL AND PATHOLOGICAL NOTES OF 13 CASES OF CARCINOMA FOLLOWING CHRONIC ULCERATIVE COLITIS

Abstracts of the clinical histories and pathological findings of each of the 13 cases of carcinoma following chronic ulcerative colitis which we have studied are now given. The cases are recorded in the order in which carcinoma was discovered. They are followed by a table summarizing the essential findings of each case.

Case 1.—Mr. W. L., 10704. When first seen, aged 51, complained of periodic attacks of diarrhœa for more than twenty-five years. Barium radiograph showed an obstructive lesion in the transverse colon. Mr. R. S. Corbett resected this by the Paul-Mikulicz method. Three months

later the colostomy was closed. After a further eight months re-admitted because of intestinal obstruction. Laparotomy revealed generalized abdominal carcinoma, from which the patient died in a few days.

Examination of the operation specimen revealed a constricting growth 4 in. in length with ill-defined edges situated in the transverse colon (*Fig.* 676). In its gross characters the lesion resembled a fibrous stricture which had infiltrated the wall of the colon, but microscopical

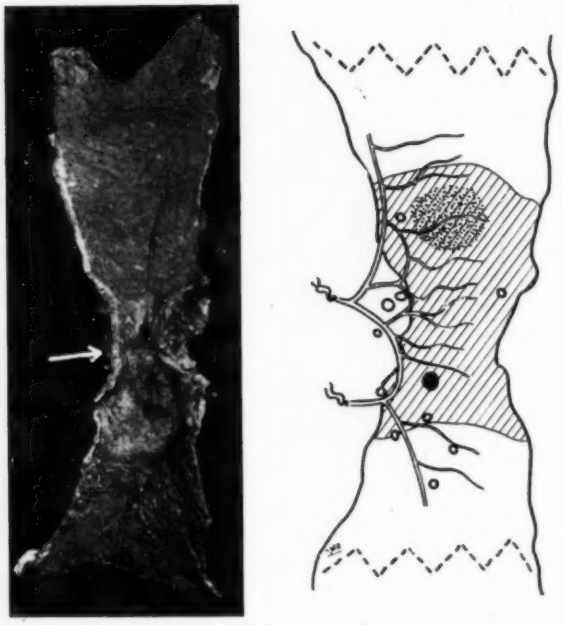

FIG. 676.—*Case* 1. Colloid carcinoma of transverse colon occurring in a case of chronic ulcerative colitis. In its gross characters the lesion resembled a fibrous inflammatory stricture. (Arrow points to tumour.)

examination showed a colloid carcinoma which had spread deeply into the mesenteric fat and caused one lymphatic metastasis. On either side of the tumour the bowel had lost its normal elasticity and sections showed inflammatory cells in the atrophic mucosa and fibrosis of the submucosa.

Case 2.—Miss R. H., 12255. When seen, aged 36, gave a history of diarrhœa and bleeding for ten years. Biopsy of an anal fistula revealed it to be infiltrated by poorly differentiated carcinoma.

Laparotomy, by Mr. W. H. Bailey, showed carcinoma of pelvic colon. Excision of rectum and left colon to mid-transverse colon performed. Good recovery from operation. Died eighteen months later, however, having developed multiple secondary deposits in skin and lymph-nodes of left axilla and groin.

Examination of the rectum and left colon removed at operation (*Fig.* 677) showed a large ulcerating tumour 3 in. in diameter which had almost completely encircled the pelvic colon. It had spread into the pericolic fat. Irregular polypoid tags below the growth showed no malignant change. Microscopical examination revealed a very anaplastic high-grade colloid carcinoma. The anal fistula also showed infiltration with colloid carcinoma.

Case 3.—Mr. E. S., 13732. First attended hospital when aged 42 and found to have granular proctitis limited to lower 6 in. of rectum. Four years later exacerbation of symptoms necessitated medical treatment in hospital. Continued in fairly good health with recurring attacks of diarrhœa and bleeding until 56 years of age when his general health deteriorated. Examination revealed an inflammatory stricture in rectum, abdominal distension, and free fluid in peritoneal cavity. Laparotomy was performed by Mr. W. B. Gabriel and generalized carcinoma found. The exact site of the primary tumour could not be determined. The patient died after a week aged 56 years.

At post-mortem examination a dense stricture was found in the transverse colon. Sections showed this to be caused by an anaplastic colloid carcinoma which had spread very extensively, giving rise to many lymphatic metastases and causing dense adhesions to the omentum and neighbouring coils of intestine.

Case 4.—Mrs. H. S., 13888. Aged 55 on first admission, but giving history of recurring attacks of colitis for more than twenty years. For the last eight months she had noticed increasing difficulty with defæcation. Examination revealed a stricture in the anal canal and lower third of rectum with a nodular granular mucosa above. Biopsy reported carcinoma. Synchronous combined excision of rectum carried out by Mr. O. V.

FIG. 677.—*Case* 2. Colloid carcinoma following chronic ulcerative colitis. Photograph of operation specimen showing polypoid growths below main tumour (marked by arrow) and photograph of gland dissection showing position of two lymphatic metastases.

Lloyd-Davies. Post-operative course uneventful. No sign of recurrence when seen three years and eight months later.

Examination of operation specimen revealed a large protuberant carcinoma in ampullary region of rectum, marked by arrow in *Fig.* 678. Beneath this the lower third of rectum and anal canal appeared to be the site of a dense fibrous stricture, but when tissue was removed from this site for section it was found that the stricture was actually due not to fibrous tissue but to a continuous downward extension of carcinoma within the submucosa, unaccompanied by visible ulceration on the surface. The extent of this downward carcinomatous growth is indicated

by the shaded area in the photograph of the gland dissection. This shows also the position of the single lymphatic metastasis.

Case 5.—Mrs. M. B., 6986. Attacks of diarrhœa began at the age of 22. When first seen at the age of 44 the bowel contained blood and pus, a rectal stricture was found at 12 cm., and several polypoid masses were noticed. Cæcostomy was carried out by Mr. C. Naunton Morgan. She attended irregularly subsequently, but when seen eleven years later was found to have a large

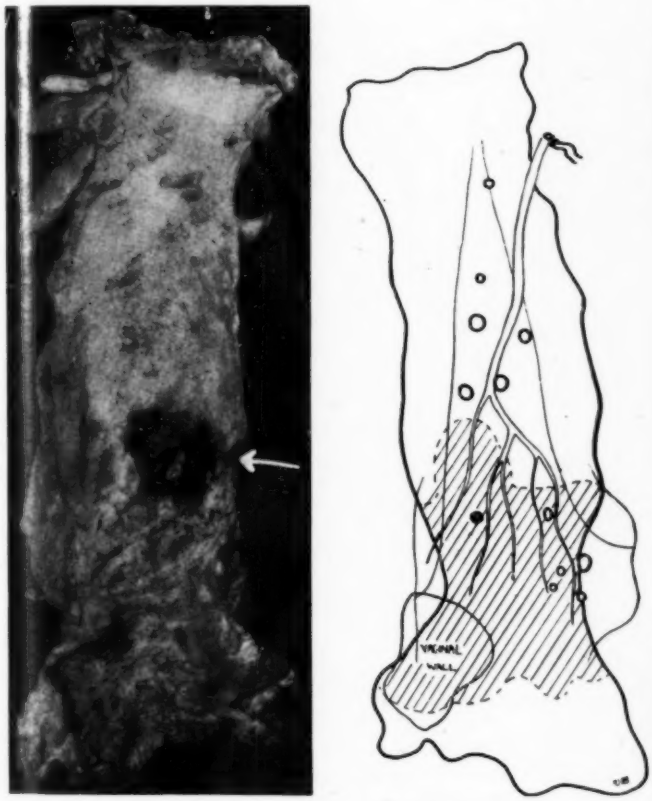

FIG. 678.—*Case* 4. Photograph of operation specimen and gland dissection from a case of rectal cancer following chronic ulcerative colitis. The tumour visible in the rectal ampulla was a villous papilloma with malignant changes. Immediately below this the lower third of the rectum appeared to be occluded by a fibrous stricture, but this proved to be due to downward extension of carcinoma in the submucous and muscle coats.

fixed mass in the rectum which biopsy proved to be a colloid carcinoma.

Synchronous combined excision of the rectum was carried out by Mr. C. Naunton Morgan, the right ovary and Fallopian tube being also removed because of involvement in the growth. Good recovery from operation, but when seen in Out-patients Department after six months was found to have massive local recurrence in pelvis. She died a few weeks later.

Examination of operation specimen showed no obvious surface growth but a solid mass of carcinoma surrounding the whole rectum (*Fig.* 679). The extent of this diffuse and intramural spread is shown by the near view picture (*Fig.* 680). Microscopical examination showed an anaplastic colloid carcinoma which had given rise to fourteen lymphatic metastases.

Case 6.—Mrs. S. S., 15049. When first seen at the age of 54 gave a history of at least eight years' ill health due to diarrhœa and bleeding per rectum. Became anæmic

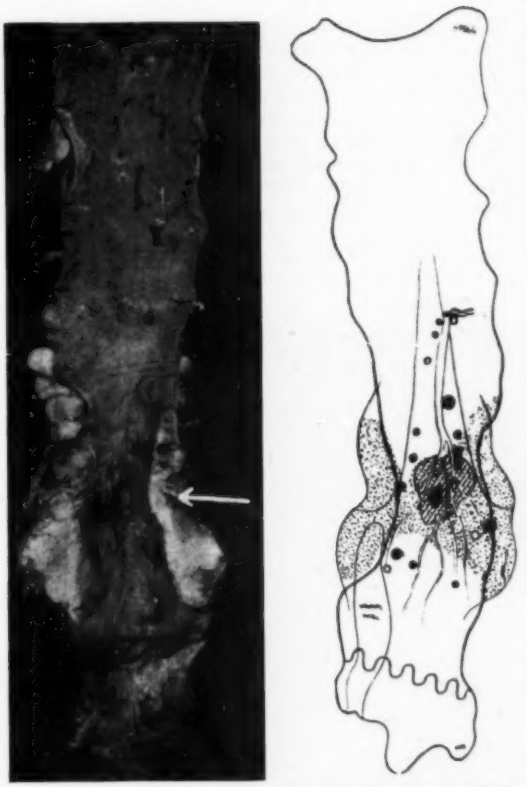

FIG. 679.—*Case* 5. Anaplastic colloid carcinoma following chronic ulcerative colitis. The photograph of the operation specimen shows the atypical appearance of the primary tumour and the photograph of the gland dissection shows the position of the lymphatic metastases and the very extensive local spread. (Arrow points to stricture.)

FIG. 680.—*Case* 5. Atypical appearance of rectal carcinoma following chronic ulcerative colitis. Higher magnification of case illustrated in *Fig.* 679.

and blood transfusion necessary. When admitted to hospital seven months later, a hard mobile mass was found in middle third of rectum. Biopsy revealed anaplastic adenocarcinoma. Ileostomy carried out by Mr. C. Naunton Morgan followed six weeks later by palliative synchronous combined excision of the rectum. Liver secondaries and peritoneal deposits found in broad ligament at operation. Three weeks later sudden death possibly from perforated peptic ulcer. No post-mortem examination.

Examination of operation specimen showed a protuberant carcinoma in rectal ampulla. Sections showed to one lymphatic metastasis. The surrounding rect l mucosa was atrophic in appearance and infiltrated wit i inflammatory cells.

Case 8.—Mrs. L. P., 8278. A woman aged 4) with a history of diarrhœa and bleeding for two year . Sigmoidoscopy showed severe chronic ulcerative colit s with pseudopolypi. Treated by appendicostomy. Du - ing the next seven years several granulomatous poly i were removed from the rectum for section but no mali - nancy found. Three years later admitted to hospit l with subacute intestinal obstruction. Treated by lapar -

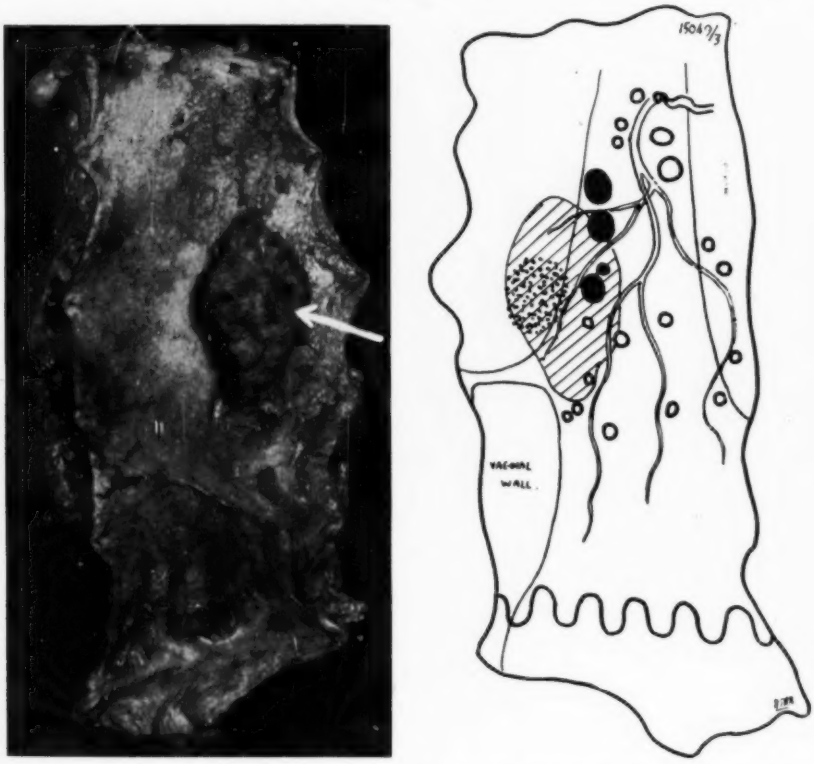

FIG. 681.—*Case* 6. Anaplastic carcinoma of rectum following chronic ulcerative colitis (marked by arrow). The position of the lymphatic metastases is indicated in the accompanying photograph of the gland dissection.

FIG. 682.—*Case* 6. Granular appearance of mucous membrane of pelvic colon in a case of rectal cancer following chronic ulcerative colitis.

the growth to be an anaplastic spheroidal-cell carcinoma simplex which had spread into the perirectal tissues and given rise to peritoneal plaques and four lymphatic metastases (*Fig.* 681). The surrounding mucosa was atrophic in appearance and in many places the mucosa had been replaced by very cellular granulation tissue (*Fig.* 682).

Case 7.—Miss A. E. J., 15096. Aged 54 when first seen because of feeling of obstruction in the rectum. History of intermittent attacks of diarrhœa for more than three years. Examination revealed a large soft villous tumour in lower third of rectum and a protuberant carcinoma immediately above. Diagnosis confirmed by biopsy. Synchronous combined excision of rectum carried out by Mr. H. R. Thompson. Slow recovery from operation. Profuse discharge from colostomy necessitated terminal ileostomy three months later, followed after an interval of another month by a subtotal colectomy. The wound broke down and the patient died from peritonitis three weeks after the last operation.

Examination of the rectum showed a colloid carcinoma arising in a pre-existing villous papilloma (*Fig.* 683). This had spread into the perirectal fat and given rise tomy and ileostomy. Left half of the colon found to be greatly thickened and dilated with evidence of chronic colitis. Pin-head-sized nodules suggestive of tuberculosis found over terminal ileum and cæcum. Shown to be secondary carcinoma by section. Death two days later, aged 50 years.

Post-mortem examination revealed large mass in pelvis surrounding rectum and dense stricture in rectosigmoid. This looked like a fibrous inflammatory stricture, but section showed it to be due to a colloid carcinoma which had spread diffusely round the bowel without giving rise to any visible tumour or ulcer on the surface. Several metastases found in hæmorrhoidal glands. Secondary deposits of carcinoma in peritoneum. Polypoid tumours present in pelvic colon.

The existence of carcinoma in this case was only discovered by microscopical examination. In its gross characters the stricture in the rectosigmoid region resembled an inflammatory stricture and the discovery of a carcinoma was a surprise to both clinician and pathologist.

Case 9.—Miss J. C., 15767. When first seen at age of 18 complained of diarrhœa and passage of blood. No

ecord of duration of symptoms. Rectal mucosa found o be pale and smooth, with loss of vascular pattern. Created by appendicostomy. Seven years later appendiostomy closed because of improvement in general ondition, but wound broke down causing fæcal fistula. Four years later when 29 years of age general condition ad deteriorated and Mr. W. B. Gabriel decided to carry ut an ileostomy followed by subtotal colectomy. The atient died from peritonitis a few weeks later.

Examination of the colon removed by subtotal colecomy revealed five separate primary carcinomas and later at the age of 60 and was then found to have a dense rectal stricture which prevented digital or instrumental examination. Inoperable fistula also present. Terminal ileostomy followed three weeks later by right hemicolectomy carried out by Mr. W. B. Gabriel. The patient's general health improved and after nine months the remaining portion of the colon was resected. The rectum was removed by perineo-abdominal excision six months later. No sign of recurrence after one year.

Examination of the second operation specimen revealed an unsuspected carcinoma in the descending colon

FIG. 683.—*Case* 7. Rectum removed by synchronous combined excision, showing fungating tumour encircling lower third and ampulla. Sections through the bowel above and below this showed the typical histology of chronic ulcerative colitis.

FIG. 684.—*Case* 9. Multiple carcinoma following chronic ulcerative colitis. Left, illustrates the appearance of a portion of the colon removed by colectomy. Small carcinomas were found in the regions marked A, B, C, D, and E. Right, illustrates the appearance of the rectum removed at autopsy three weeks later. A sixth carcinoma was found at the place marked by an arrow.

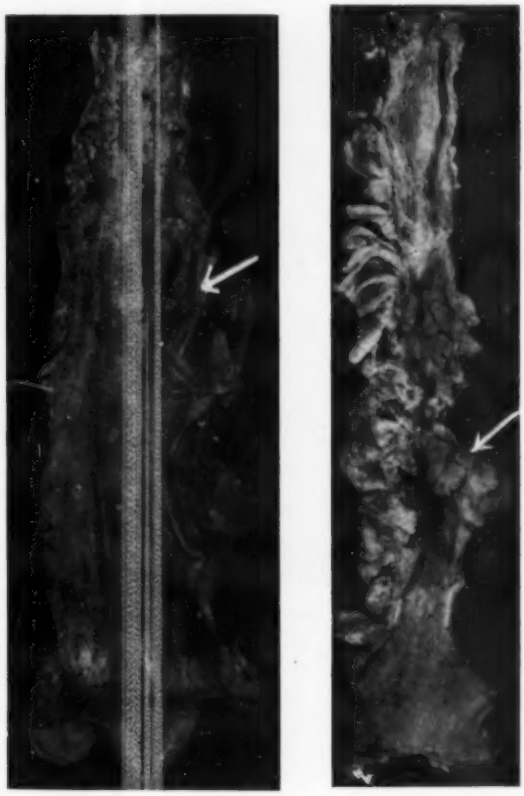

FIG. 685.—*Case* 10. Carcinoma of descending colon with ill-defined margins spreading over more than 6 in. of the bowel, occurring in a case of chronic ulcerative colitis. (Arrow points to stricture.)

subsequent examination of the rectum removed at autopsy led to the discovery of a sixth carcinoma. The growths in the colon appeared as small shallow ulcers with raised hard edges (*Fig.* 684). Their position is indicated by the letters A, B, C, D, and E in the photograph of the operation specimen. The tumours were more easily felt than seen and are scarcely visible in the photograph. The rectal tumour found at autopsy was larger in size. Its position is marked by an arrow in the photograph. All six tumours were examined microscopically and proved to be separate primary adenocarcinomas. They had all spread more extensively in the submucosa and muscle than in the mucosa, and one had already given rise to a lymphatic metastasis.

Case 10.—Mr. E. S., 6304. When first seen at the age of 47 the rectal mucosa was granular in appearance and showed an early stricture. The patient gave a history of recurring attacks of diarrhœa for more than twenty-five years. He returned for further treatment thirteen years (*Fig.* 685). This had caused a stricture with ill-defined margins, stretching over more than 6 in. of the bowel. Sections showed an adenocarcinoma of a low histological grade of malignancy which had spread extensively locally but not caused lymphatic metastases.

Case 11.—Miss G. R., 15957. Onset of colitis at age of 23 years. Operation for anal fistula twelve years later. Intermittent attacks of colitis followed until the development of carcinoma of rectum after twenty-three years. Had been confined to bed for previous six months.

Abdominoperineal excision of the rectum performed by Mr. O. V. Lloyd-Davies. Colitis limited to rectum and pelvic colon. Fourteen months later found to have extensive recurrence of colloid carcinoma in bladder.

Examination of the operation specimen (*Fig.* 686) showed a huge ulcerating growth 6 in. in length which completely encircled the whole of the rectum. Microscopical examination proved the lesion to be a colloid carcinoma of a high grade of malignancy which had spread

through the rectal muscle and extensively invaded the perirectal fat (*Fig.* 687). All eighteen lymphatic glands in the specimen were involved by growth.

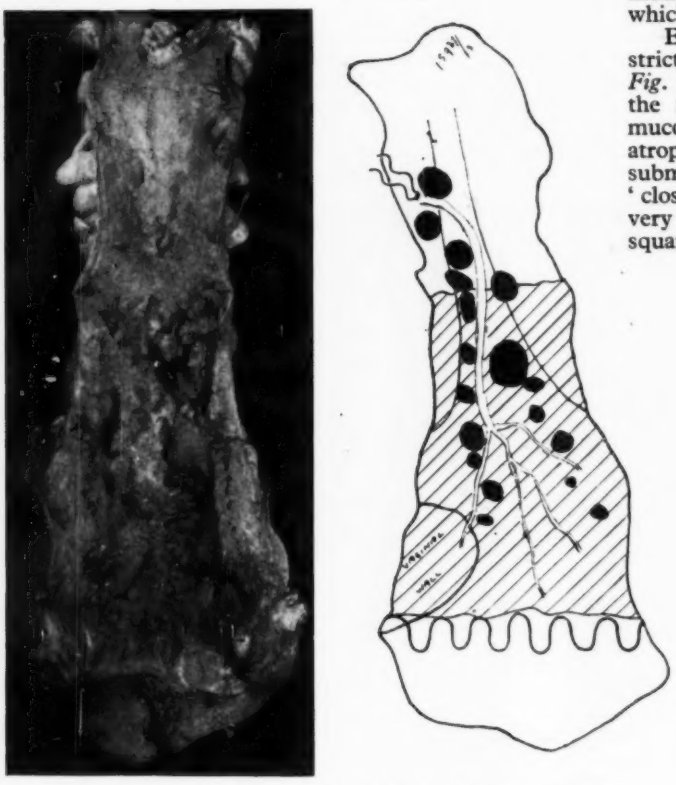

FIG. 686.—*Case* 11. Colloid carcinoma arising in a case of chronic ulcerative colitis. Photograph of operation specimen and gland dissection showing position of glandular metastases.

Case 12.—Mrs. R. D., 16398. Periodic attacks of diarrhœa and bleeding from 25 to 45 years of age culminating in admission as an intestinal emergency with clinical picture of obstruction.

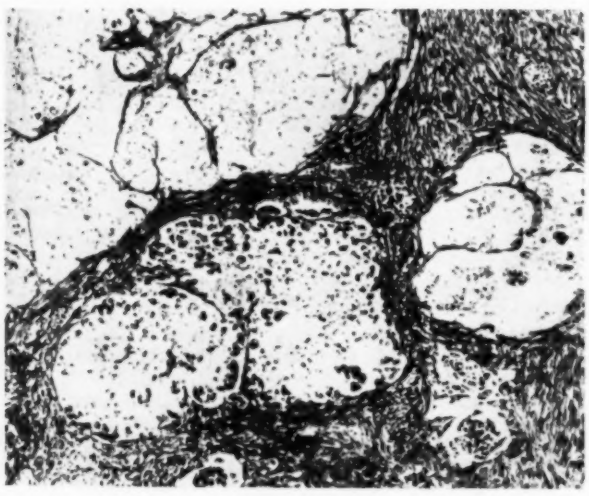

FIG. 687.—*Case* 11. Colloid carcinoma of high-grade malignancy in a case of chronic ulcerative colitis. (× 40.)

Cæcostomy performed to relieve obstruction. Free fluid found in peritoneum. Barium enema showed strictures in transverse and sigmoid colon. Terminal ileostomy, and a few weeks later subtotal colectom carried out by Mr. W. B. Gabriel. Good recovery fro operation but patient returned to hospital after thr months with generalized abdominal carcinoma fro which she died, aged 46.

Examination of operation specimen showed a co stricting carcinoma (marked by arrow in photograp *Fig.* 688). Proximal to this the bowel was dilated an the mucosa ulcerated. Distal to the obstruction th mucosa was pale and microscopical examination showe atrophy of the mucous membrane and fibrosis of th submucosa (*Fig.* 689). The constricting tumour, ' close-up ' of which is illustrated in *Fig.* 690, was very anaplastic adenocarcinoma showing a tendency squamous cell metaplasia in some places. It was ver

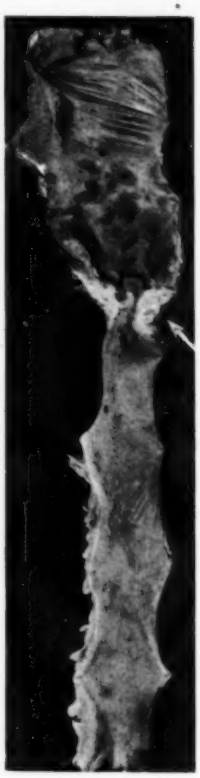

FIG. 688.—*Case* 12. Anaplastic adenocarcinoma of transverse colon following chronic ulcerative colitis causing dense stricture.

invasive in character and had spread extensively beyond its visible margins and given rise to three lymphatic metastases. Judged from its histology the growth was of a high grade of malignancy. The patient's subsequent rapid decline confirmed this.

Case 13.—Mrs. G. W., 17140. A female aged 53 when first seen. History of symptoms of colitis for twenty years: more severe for several months, with diarrhœa and passage of blood, loss of weight, and abdominal distension. Carcinomatous stricture found in lower third of rectum, confirmed by biopsy. Synchronous combined excision of the rectum and left colon carried out by Mr. E. T. C. Milligan. Good recovery from operation, but vaginal recurrence two months later.

Examination of operation specimen revealed a dense stricture in the lower third of the rectum unaccompanied by any visible tumour or ulcer on the surface. The stricture was caused by a colloid carcinoma which had spread diffusely in the submucous and muscle coats forming a dense mass of yellowish-white hard tissue

(*Fig.* 691). Sections showed the growth to be an anaplastic colloid carcinoma of a high grade of malignancy which had given rise to fourteen lymphatic metastases, the position of which is shown in the photograph of the gland dissection.

DISCUSSION

All these 13 cases of carcinoma following chronic ulcerative colitis had two characteristics in common. In the first place the outward appearance of the malignant tumour was unusual, so much so in some cases that the presence of malignancy was unsuspected. This is indeed surprising when one recollects that most tumours of the rectum and colon are easily recognizable as neoplastic lesions though microscopical examination may be needed to decide whether or not the tumour is malignant. But malignant tumours following chronic ulcerative

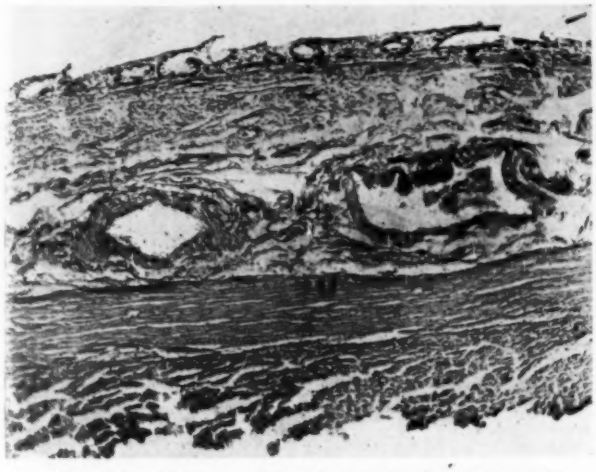

FIG. 689.—*Case* 12. Photomicrograph of section passing through pale area distal to tumour, showing atrophy of mucous membrane and fibrosis of submucosa. (× 56.)

colitis may be unrecognizable by the unaided eye, because in this altered soil growth proceeds in an unfamiliar way. Therefore the first characteristic to which we wish to draw attention is that a carcinoma following chronic ulcerative colitis may not cause a visible tumour or ulcer on the surface but may manifest itself only as a dense fibrous-looking stricture with ill-defined boundaries, resembling an inflammatory rather than a neoplastic lesion.

Secondly, when carcinoma follows chronic ulcerative colitis it usually grows very rapidly. In nearly all the cases we have studied the tumour was anaplastic in character, having the histology of an undifferentiated colloid carcinoma or an adenocarcinoma of a high grade of malignancy. Also these growths were exceptionally invasive in character, spreading intramurally by infiltration within the submucosa and muscle coat, well beyond the visible boundaries of the surface lesion. Lymphatic spread also occurred at an unusually early stage. In our series of 13 cases of cancer following chronic ulcerative colitis only one tumour had not given rise to lymphatic metastases, whereas in other cases of cancer of the rectum and colon operated on during the same period approximately half showed no lymphatic spread. Finally in cancer following chronic ulcerative colitis the average number of lymphatic metastases is greater than for other cases, all of which indicates a bad prognosis, which our follow-up records abundantly confirm.

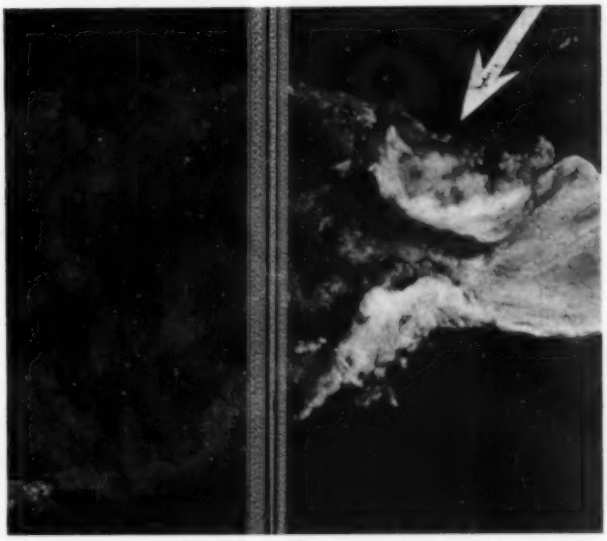

FIG. 690.—*Case* 12. Higher magnification of tumour illustrated in *Fig.* 688, showing ulceration proximal to growth (marked by arrow) and pale atrophic appearance of mucosa distal to growth.

We have described the atypical appearance and rapid growth of cancer following chronic ulcerative colitis as though they were independent features, but

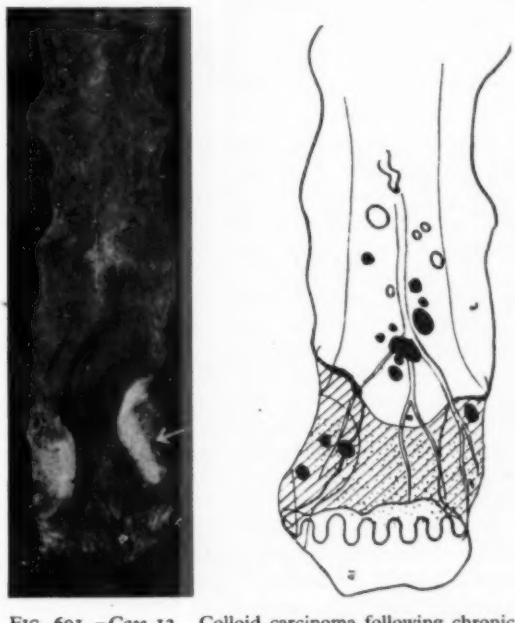

FIG. 691.—*Case* 13. Colloid carcinoma following chronic ulcerative colitis. The photograph of the operation specimen shows the atypical appearance of the primary tumour which had caused a dense stricture in the lower third of the rectum without any obvious surface growth. The photograph of the gland dissection shows the very extensive local spread and the position of the fourteen lymphatic metastases. (Arrow points to stricture.)

actually this is not so; on the contrary they are closely inter-related. The atypical appearance of the primary tumour is the direct consequence of exceptionally rapid and invasive growth. Very similar

appearances result from the rapid growth of an anaplastic carcinoma which has not been preceded by chronic ulcerative colitis.

The rapid growth of cancer following chronic ulcerative colitis raises the question of early diagnosis and whether or not this could be assisted by the recognition of any precancerous stage, using the term 'precancerous' to describe lesions which are known frequently to precede cancer. This way of approach has often proved useful. For instance familial polyposis is now recognized to be a precancerous lesion and this has led to the earlier diagnosis of cancer in affected families. Is there evidence of any similar precancerous lesion in chronic ulcerative colitis?

Table I.—SUMMARY OF ESSENTIAL FINDINGS

CASE	SEX	AGE AT ONSET OF ULCERATIVE COLITIS	DURATION IN YEARS OF ULCERATIVE COLITIS BEFORE THE FINDING OF CARCINOMA	HOW CARCINOMA WAS DIAGNOSED	SITE OF CARCINOMA	HISTOLOGY AND GRADING	*EXTENT OF SPREAD OF CARCINOMA WHEN DIAGNOSED	OUTCOME
1	M.	26	25	Suspected radiologically. Found at operation	Transverse colon	Colloid carcinoma. Low grade	C	Died 11 months after resection. Recurrence
2	F.	26	10	Suspected clinically. Found at operation	Pelvic colon	Colloid carcinoma. High grade	C	Died 18 months after resection. Recurrence
3	M.	Approx. 42	14	Suspected radiologically. Found at operation	Transverse colon	Colloid carcinoma. High grade	C Peritoneal deposits	Died 8 days after laparotomy
4	F.	35	20	Clinically	Rectum	Adenocarcinoma. Low grade	C	Clinically no recurrence 44 months later
5	F.	22	33	Clinically	Rectum	Colloid carcinoma. High grade	C Peritoneal deposits	Died 7 months after resection. Recurrence
6	F.	46	8	Clinically	Rectum	Carcinoma simplex	C Liver and peritoneal deposits	Died 23 days after palliative resection
7	F.	51	3	Clinically	Rectum	Colloid carcinoma. Average grade	C	Died 23 days after colectomy. Rectum resected 4 months previously
8	F.	38	13	Unexpected finding at post-mortem examination	Rectum	Colloid carcinoma. High grade	C Peritoneal deposits	Died 2 days after ileostomy
9	F.	Approx. 18	12	Unexpected finding at laparotomy	Multiple	All adenocarcinomata. Low grade	C Peritoneal deposits	Died 16 days after subtotal colectomy
10	M.	24	37	Unexpected finding during colectomy	Descending colon	Adenocarcinoma. Low grade	B	Alive—no recurrence 11 months after operation
11	F.	23	23	Clinically	Rectum	Colloid carcinoma. High grade	C	Alive 14 months later. Bladder recurrence
12	F.	25	20	Suspected radiologically. Confirmed by laparotomy	Transverse colon	Adenocarcinoma. High grade	C	Died 5 months after colectomy
13	F.	33	20	Clinically	Rectum	Colloid carcinoma. High grade	C	Alive—vaginal recurrence 2 months after excision of rectum

* Stage I or A case: Growth limited to rectum or colon.
Stage II or B case: Growth extending beyond bowel but no lymphatic metastases.
Stage III or C case: Lymphatic metastases present.

Pseudo-polypi and Their Relationship to Carcinoma.—It is well known that polypoid lesions, usually described as 'pseudo-polypi', are common in chronic ulcerative colitis. Felsen and Wolarsky (1949) found them in 15·7 per cent of 855 cases of chronic ulcerative colitis, and Bargen and Dixon (1935) in one of their earlier papers said they had found polypi in 10 per cent of all cases of long-standing chronic ulcerative colitis. Willard, Pessel, Hundley, and Bockus (1938), in a series of 66 cases of chronic ulcerative colitis, found polypi in 39 per cent. Many other authors have commented on the association of polypi with chronic ulcerative colitis and Bargen and Sauer (1944) and Gleckler and Brown (1950) found them more frequently in cases of chronic ulcerative colitis in which carcinoma also was present.

There has been a divergence of opinion as to the significance of these polypoid lesions. Some authors

have regarded them as precancerous whereas others have doubted this. Yeomans (1927) and Bargen (1928) were amongst the first to suggest that there is a definite sequence of events which can be traced through the stages of inflammatory hyperplasia, adenoma, and carcinoma, and cases have been published, as for instance by Johnson and Orr (1948), describing the development of carcinoma from adenomatous polyps in chronic ulcerative colitis. Rankin (1939) declared that cancer develops in about 2·5 per cent of cases of pseudopolyposis following chronic ulcerative colitis.

In opposition to this Swinton and Warren (1939) expressed the opinion that there is no evidence that pseudo-polypi in chronic ulcerative colitis are precancerous and Hardy, Brooke, and Hawkins (1949)

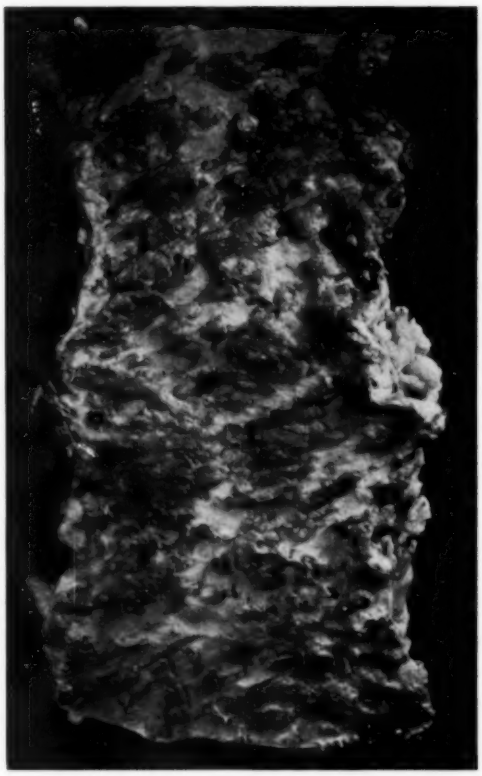

FIG. 692.—Chronic ulcerative colitis. Ragged appearance of mucous membrane of the colon in a fatal case of chronic ulcerative colitis. 'Mucosal tags' only. (Inch scale.)

doubted if the presence of such polypi carried any risk of potential malignancy.

We think that the main reason for this divergence of opinion is failure to discriminate between different varieties of polypi. The word 'polypus' is used to describe any polypoid lesion whatever its histological structure. The polypoid lesions which occur in chronic ulcerative colitis are of three quite distinct varieties—namely, (1) mucosal tags, (2) inflammatory polyps, and (3) adenomatous polyps. These differ in their structure and significance.

Mucosal tags are simply surviving fragments of mucous membrane still anchored to the bowel wall but projecting into the lumen (*Fig.* 692). They occur following the ulcerative stage of the disease. They have a ragged appearance and on section are seen to be composed only of irregular tags of mucous membrane.

Inflammatory polyps are more rounded in appearance and often definitely pedunculated. They are usually pale, much paler than adenomas. In the early stages of development they are composed of mucous membrane and granulation tissue, but at a later stage they consist only of a compact core of connective tissue covered by fairly normal looking glandular epithelium (*Fig.* 693). They may disappear spontaneously and often do so. They are not in any sense precancerous.

Adenomatous polyps are much less common. They have the same rounded outline and are also pedunculated but differ from inflammatory polyps in being

FIG. 693.—Chronic ulcerative colitis. Section through inflammatory polyp from colon in chronic ulcerative colitis. Note central fibrous core covered with glandular epithelium. (× 12.)

darker in colour and firmer in consistence (*Fig.* 694). On section they are composed, at any rate in part, of closely packed non-mucus secreting, columnar epithelial cells with hyperchromatic nuclei. They are true adenomas and definitely precancerous, in the sense that cancer often develops within them.

In our view the relation between pseudo-polypi and carcinoma can be expressed quite simply as follows: The commonest varieties of pseudo-polypi are mucosal tags and inflammatory polyps and these are not to be regarded as precursors of cancer. Adenomatous polyps are much less common but definitely precancerous. Therefore special care is needed in the supervision of any patient who has had chronic ulcerative colitis and who is known to have adenomatous polyps in the rectum.

The early recognition of precancerous lesions would of course improve the results of the surgical treatment of cancer following chronic ulcerative colitis but in a very small proportion of cases only. We say this because polypoid lesions do not occur in all cases and in only a small proportion of these are adenomatous polyps found. So that although cancer following chronic ulcerative colitis may begin as an adenomatous polyp we do not think it does so often. In fact, when we reflect on our experience we are struck by the fact that carcinoma so frequently develops without any visible or recognizable neoplastic lesion on the surface. We do not think that

this disconcerting fact has been considered sufficiently in the past.

The Incidence of Carcinoma in Chronic Ulcerative Colitis.—The true incidence of carcinomatous change is difficult to assess for several reasons. Obviously the period of observation has a bearing on the number of cases of carcinoma to be found in any series of chronic ulcerative colitis. This was recognized by Cattell (1948), who found that one in three

FIG. 694.—Chronic ulcerative colitis. Colectomy specimen showing pale atrophic mucous membrane. The darker pedunculated tumours are true adenomatous polyps.

cases developed carcinoma when the ulcerative colitis had been present for nine years or more. In our St. Mark's series of 63 cases treated surgically there were 7 cases of carcinoma, showing a total incidence of 11·1 per cent. But if these 63 cases are divided into two groups, those with more and those with less than ten years' history, the importance of the duration of the disease in relation to carcinoma becomes apparent at once. Thus in our series there were 52 cases who were known to have had the disease for ten years or less, and in this group there were only 2 cases of carcinoma. On the other hand amongst the 11 cases with a history of ulcerative colitis for more than ten years there were 5 cases of carcinoma. In other words almost half of the severe cases of chronic ulcerative colitis who survived for more than ten years developed carcinoma of the bowel. This emphasizes once more the fact that the period during which carcinoma is most likely to develop is after the colitis has been in existence for ten to fifteen years. This is remarkably similar to what has been observed in familial polyposis, another precancerous lesion which is apt to be followed by carcinoma after a similar latent period. The age of onset of chronic ulcerative colitis was found by Jackman et al. (1940) to be of significance in that the incidence of carcinoma was nearly twice as high when the colitis started before the age of 16 years. The severity of the disease is another factor to be considered. Possibly the commoner and milder forms of chronic ulcerative colitis are less likely to be followed by carcinoma. If this is so, it would partly explain the wide variation in the findings of different authors regarding the incidence of carcinoma. The assessment of carcinomatous change is further complicated by surgery since it is not unlikely that some of the cases submitted to colectomy would have developed carcinoma had the colon not been removed. In regard to this point, it is interesting to note that in two of our cases the cancer was found unexpectedly in operation specimens. We would like to point out that the two characteristics to which we have drawn attention—namely, the atypical appearance and the rapid spread—have a bearing on the question of how frequently cancer follows in the wake of chronic ulcerative colitis. It would be easy to overlook a carcinoma following chronic ulcerative colitis even at post-mortem examination on a fatal case, and the clinical diagnosis is obviously even more liable to error. The early symptoms of malignancy might easily be attributed to an exacerbation of the colitis and later symptoms such as intestinal obstruction might equally naturally be ascribed to the development of inflammatory stricture. For which reasons we think that in the past malignancy has been overlooked and its incidence underestimated.

CONCLUSIONS

Our study of the clinical history and pathology of 13 cases of cancer of the rectum or colon following chronic ulcerative colitis has led us to the following four conclusions :—

1. That carcinoma occurs more frequently in patients who have had chronic ulcerative colitis than in those who have not had this disease : in other words, chronic ulcerative colitis predisposes to carcinoma.

2. The extent of this predisposition to carcinoma has been underestimated in the past because patients have not been kept under adequate supervision and because of the clinical and pathological difficulties in diagnosis. In the St. Mark's series of 63 surgically treated cases of chronic ulcerative colitis the incidence of carcinoma was 11·1 per cent, but in those 11 cases of chronic ulcerative colitis which survived for more than ten years 5 cases ultimately developed carcinoma—almost half. It is obvious that the percentage of malignancy recorded in any series of cases will vary with the severity of the disease, its duration, the age of the patients, the period of observation and the experience of the observer.

3. When carcinoma follows chronic ulcerative colitis it usually grows rapidly and metastasizes early. It may cause no recognizable surface tumour or ulcer but only a diffuse stricture resulting from intramural spread of carcinoma. In its histology the growth is usually a colloid or mucus-secreting carcinoma, often of a high grade of malignancy.

4. Carcinoma following chronic ulcerative colitis has a very bad prognosis. This is due to the rapid spread of the tumour and to difficulties in diagnosis. Most patients are already incurable by the time carcinoma has been diagnosed.

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THE SIGNIFICANCE OF THE LEVEL OF THE PERITONEAL REFLECTION IN THE SURGERY OF RECTAL CANCER

BY M. R. EWING*

THE anatomical nomenclature of the distal colon has, within the past twenty years or so, been subject to frequent revision but remains still rather confused and indefinite. It is certainly true that the practising proctologist has, for long, been dissatisfied with the anatomy of this area as he finds it in the standard text-books. How inadequate, for example, is the account given there of the detailed arrangement of the complicated components of the sphincter mechanism. Little wonder that Milligan and Morgan (1934) felt compelled to give us a much more exact description based, not only on dissections in the cadaver, but on experience in the palpation and exposure of living, contracting muscles. But it has been less the apparent deficiencies in the standard description and more the surgeon's approach, so different as it is from that of the pure anatomist, which has led him to introduce, here and there, a new terminology. He has not even hesitated, at times, to defy the anatomist: as for example when he established for the pelvic colon, and for the rectum and anus, new limits which he found more useful than the old in pathological and in operative description (Gabriel, 1949). Although some of the changes in nomenclature have proved very helpful to the surgeon, they have by no means made for greater accuracy in description, and curious inconsistencies have found their way into surgical writings.

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It is also true that from the pathological (and this is especially true of cancer) as well as from the operative point of view, the distal part of the colon seems properly to belong to the rectal segment, a point with which the writings of Miles (1944) have made us fully aware.

But despite, or perhaps because of, the close affinity between the distal colon and the rectum, both in the operative techniques required and in their pathology, I still believe that the term 'rectosigmoid' is an unsatisfactory one, often applied loosely to an ill-defined length of bowel much of which may deserve, more correctly, to be called 'sigmoid'.

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* From the Department of Surgery, Postgraduate Medical School of London, Hammersmith Hospital.

this disconcerting fact has been considered sufficiently in the past.

The Incidence of Carcinoma in Chronic Ulcerative Colitis.—The true incidence of carcinomatous change is difficult to assess for several reasons. Obviously the period of observation has a bearing on the number of cases of carcinoma to be found in any series of chronic ulcerative colitis. This was recognized by Cattell (1948), who found that one in three

FIG. 694.—Chronic ulcerative colitis. Colectomy specimen showing pale atrophic mucous membrane. The darker pedunculated tumours are true adenomatous polyps.

cases developed carcinoma when the ulcerative colitis had been present for nine years or more. In our St. Mark's series of 63 cases treated surgically there were 7 cases of carcinoma, showing a total incidence of 11·1 per cent. But if these 63 cases are divided into two groups, those with more and those with less than ten years' history, the importance of the duration of the disease in relation to carcinoma becomes apparent at once. Thus in our series there were 52 cases who were known to have had the disease for ten years or less, and in this group there were only 2 cases of carcinoma. On the other hand amongst the 11 cases with a history of ulcerative colitis for more than ten years there were 5 cases of carcinoma. In other words almost half of the severe cases of chronic ulcerative colitis who survived for more than ten years developed carcinoma of the bowel. This emphasizes once more the fact that the period during which carcinoma is most likely to develop is after the colitis has been in existence for ten to fifteen years. This is remarkably similar to what has been observed in familial polyposis, another precancerous lesion which is apt to be followed by carcinoma after a similar latent period. The age of onset of chronic ulcerative colitis was found by Jackman et al. (1940) to be of significance in that the incidence of carcinoma was nearly twice as high when the colitis started before the age of 16 years. The severity of the disease is another factor to be considered. Possibly the commoner and milder forms of chronic ulcerative colitis are less likely to be followed by carcinoma. If this is so, it would partly explain the wide variation in the findings of different authors regarding the incidence of carcinoma. The assessment of carcinomatous change is further complicated by surgery since it is not unlikely that some of the cases submitted to colectomy would have developed carcinoma had the colon not been removed. In regard to this point, it is interesting to note that in two of our cases the cancer was found unexpectedly in operation specimens. We would like to point out that the two characteristics to which we have drawn attention—namely, the atypical appearance and the rapid spread—have a bearing on the question of how frequently cancer follows in the wake of chronic ulcerative colitis. It would be easy to overlook a carcinoma following chronic ulcerative colitis even at post-mortem examination on a fatal case, and the clinical diagnosis is obviously even more liable to error. The early symptoms of malignancy might easily be attributed to an exacerbation of the colitis and later symptoms such as intestinal obstruction might equally naturally be ascribed to the development of inflammatory stricture. For which reasons we think that in the past malignancy has been overlooked and its incidence underestimated.

CONCLUSIONS

Our study of the clinical history and pathology of 13 cases of cancer of the rectum or colon following chronic ulcerative colitis has led us to the following four conclusions :—

1. That carcinoma occurs more frequently in patients who have had chronic ulcerative colitis than in those who have not had this disease : in other words, chronic ulcerative colitis predisposes to carcinoma.

2. The extent of this predisposition to carcinoma has been underestimated in the past because patients have not been kept under adequate supervision and because of the clinical and pathological difficulties in diagnosis. In the St. Mark's series of 63 surgically treated cases of chronic ulcerative colitis the incidence of carcinoma was 11·1 per cent, but in those 11 cases of chronic ulcerative colitis which survived for more than ten years 5 cases ultimately developed carcinoma—almost half. It is obvious that the percentage of malignancy recorded in any series of cases will vary with the severity of the disease, its duration, the age of the patients, the period of observation and the experience of the observer.

3. When carcinoma follows chronic ulcerative colitis it usually grows rapidly and metastasizes early. It may cause no recognizable surface tumour or ulcer but only a diffuse stricture resulting from intramural spread of carcinoma. In its histology the growth is usually a colloid or mucus-secreting carcinoma, often of a high grade of malignancy.

4. Carcinoma following chronic ulcerative colitis has a very bad prognosis. This is due to the rapid spread of the tumour and to difficulties in diagnosis. Most patients are already incurable by the time carcinoma has been diagnosed.

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years ago, was responsible for the introduction of this term. He had noticed not only in the cadaver, but at operation as well, that there was often an appreciable narrowing of the bowel to mark the point at which the sigmoid and the rectum merged, and he believed that there was at this level "the hint" of a sphincter mechanism. This narrowed area he called the 'rectosigmoid', being careful to define it further as the last 2 inches of the sigmoid and the first 1½ inches of the rectum above the right single valve of Houston (*see below*).

It is my contention, however, that not even this account of Mayo's can be considered to be a sufficiently accurate and workable description. Buie (1937), for example, found it necessary to re-define the rectosigmoid as that part of the large bowel which is supplied by rectosigmoid arteries, but this terminology implies, in turn, a careful definition of these vessels. Surgeons have become increasingly interested in recent years, since the development of sphincter-saving operations for rectal cancer, in the applicability of various operative procedures to tumours at differing levels in the rectum. I have become acutely aware in consulting this literature that, in the descriptions of the usefulness of these varying techniques, exact anatomical description is often disturbingly scanty so that really convincing comparison between one procedure and the next is impossible. Gilchrist and David (1948) have more than once (and in this they have been by no means alone) complained in particular, of the careless use of the term 'rectosigmoid' and have made a plea for its complete rejection. More recently Pfeiffer and Miller (1950) have made a similar plea, again on the grounds of scientific accuracy, for the dropping from our descriptive vocabulary of this vague and unsatisfactory term.

WHERE DOES THE RECTUM BEGIN?

If then there is a case for the abandonment of the term 'rectosigmoid', how are we to recognize at operation the upper limit of the rectum: is there any level which we can accept as a standard, which will be clearly understood by our surgical colleagues and equally apparent to our pathological confrères?

Wood Jones (1911) takes the first valve of Houston (*see below*) as the level of the rectosigmoid junction, but this is unfortunately a landmark which can be seen only on inspection of the interior of the gut. He admits that, although this junction may often be opposite the third piece of the sacrum, it is subject to considerable variation. He points out, however, that where the sigmoid joins the rectum there occur certain fundamental changes in the structure of the bowel. It is here, for example, that the mesocolon ceases and the three tæniæ fuse to form two broad bands, one in front and one behind. At this level, too, the appendices epiploicæ disappear and the main trunk of the superior hæmorrhoidal artery divides into its two terminal branches, which run down along the side of the rectum close to the line of the peritoneal reflection. Villemin and his co-workers (Villemin, Huard, and Montagné, 1925) also found in their examination of the fœtal colon that this level is constantly marked by two subterminal branches of the main superior hæmorrhoidal trunk, which encircle the bowel just opposite Houston's first valve. However, even with these changes as guides, it is still often exceedingly difficult at operation to say precisely where the rectum begins. It is, of course, this state of affairs as much as any other which has made the term 'rectosigmoid' so long acceptable.

Although it is not relevant to my theme, I cannot refrain from adding that just as it is difficult to say precisely where the rectum begins, so there seems to be little uniformity of description of the point at which the rectum joins the anal canal, or, for that matter, of the exact position of the anal orifice itself.

THE LEVEL OF THE PERITONEAL REFLECTION

We commonly indicate the site of a rectal cancer by measuring the distance of its lower edge from the anal margin, or, as some prefer, from the pectinate line. I never know which is the 'pectinate line' and which the 'white line of Hilton'. Does the latter correspond to the anal intermuscular septum of Milligan and Morgan (1934)? Buie (1937), I find, maintains that this 'line' (of Hilton) is not recognizable in an undissected specimen except by palpation and holds that Hilton (1876) was wrong in believing—as was presumably Miles (1944) many years later—that it marks the position of the mucocutaneous junction.

The distance, as measured from the perineum, may, however, vary considerably, depending no doubt on factors such as the patient's position on the table or the tone of his sphincters, and, most important of all, on the presence or absence of any degree of intussusception of the tumour. The height of the tumour is measured, now in centimetres and now in inches; now in the living subject and now in the resected specimen, where it may be either shrunken and twisted into a miserable shadow of its former self or grown big as it lies tightly stretched and mounted on a frame. The sigmoidoscope measures the shortest distance of the lower edge of a tumour from the anal margin, but when at operation the curves of the rectum are obliterated by its dissection out of the hollow of the sacrum, this length will be very considerably increased.

To my mind, the only really helpful landmark in the anatomy of the rectum is the peritoneal reflection—meaning the point at which the serous investment passes forward in front to the bladder or vagina. The pathologist can in the resected specimen see it and mark it; he can tell whether the growth is above or below, or at the reflection. When a surgeon reads in the operation notes of the relationship of a tumour to the peritoneum of the pelvic floor, he can immediately visualize very much more clearly and accurately than from measurement alone, not only the technical problem entailed in its resection but the pathological implications as well of a tumour at this level, whether it be in a female with a low peritoneal reflection or in a male with a high one (d'Allaines, 1946). It is true that the distance of the reflection from the perineum will vary considerably—from 5 cm. to 10 cm. (Kirklin, Dockerty, and Waugh, 1949): in a woman who has borne children, and especially if there is any considerable degree of rectocele, it will come very close to the anal margin. It is, however, my

f m belief that the peritoneal reflection is a valuable l ndmark in surgical practice, readily recognizable a operation and equally evident in the resected s ecimen.

But not only is it a surgical landmark: it is an a natomical level of the very greatest significance as v ell.

This was pointed out with his usual clarity and c gmatism by Wood-Jones (1911) in a characteri tic communication to the surgical section of the R oyal Society of Medicine when introducing v hat turned out to be a prolonged and bitter d scussion on cancer of the rectum. He first r viewed the varying nomenclature which h d been adopted by anatomists up to that t me and expressed his dissatisfaction with t em all. He was firmly of the opinion that t ere was no good trying to relate the rectum t bony points, as the position of that viscus w s subject to such wide variation. Some y ars before (Wood-Jones, 1904) he had m de a study of the embryology of the hindg t in relation to the varying degrees of r ctal atresia, and from these researches he w s convinced that, from the developmental p int of view, the rectum consists of two distinct portions (*Fig.* 695):—

a. The 'old' rectum, which is derived from the last part of the hindgut.

b. The 'new' rectum, which is developed from the post-allantoic gut.

The 'old' rectum he believed to end, in the male, at the level of the prostatic urethra (the common site of a recto-urethral fistula, when the 'new' rectum fails to develop) and further, that this point corresponds to the level of the reflection of the peritoneum from the posterior aspect of the bladder at the bottom of the rectovesical pouch. The portion of the rectum above this level, he felt, should be regarded as a pelvic organ distinct in many ways from the segment which lies below. It expands into the peritoneal cavity in contrast to the 'new' or 'perineal' rectum which is surrounded by the fascial layers of the pelvic cavity proper. The 'perineal' rectum he defined as ending below at the lower margin of the anal valves which mark the junction of the entoderm of the hindgut with the ectoderm of the proctodeum.

Almost exactly a century earlier, Houston (1830), a Dublin anatomist, had described four valves which he believed to be constantly present in the rectum and which have since been called by his name. Wood-Jones (1911) was of the opinion that the second and fourth of these folds (numbering them as Houston did proximal-distally) are inconstant and variable in position and of no significance, but that the first and third are always present and are marked by the thickenings and infoldings of the muscle coat—meriting, in fact, almost the dignity of the appellation 'sphincter'. It is at the level of the third that the ultimate branchings of the superior haemorrhoidal vessels penetrate the wall of the rectum before they run downwards in the submucosa to raise a row of vertical mucosal folds. It is this third (and right) valve which we can almost invariably recognize at sigmoidoscopy when we must direct the beak of the instrument past its projecting border —what is sometimes called 'Nélaton's sphincter' or 'sphincter ani tertius'. It lies precisely at the level of the peritoneal reflection and marks the junction of the 'pelvic' and 'perineal' segments of the rectum which Wood-Jones described. It is worth noting that this significant level in the bowel (if significant it is) can thus be recognized readily first, from without, by the points at which the peritoneum leaves the rectum in front and, from within, by Houston's third valve.

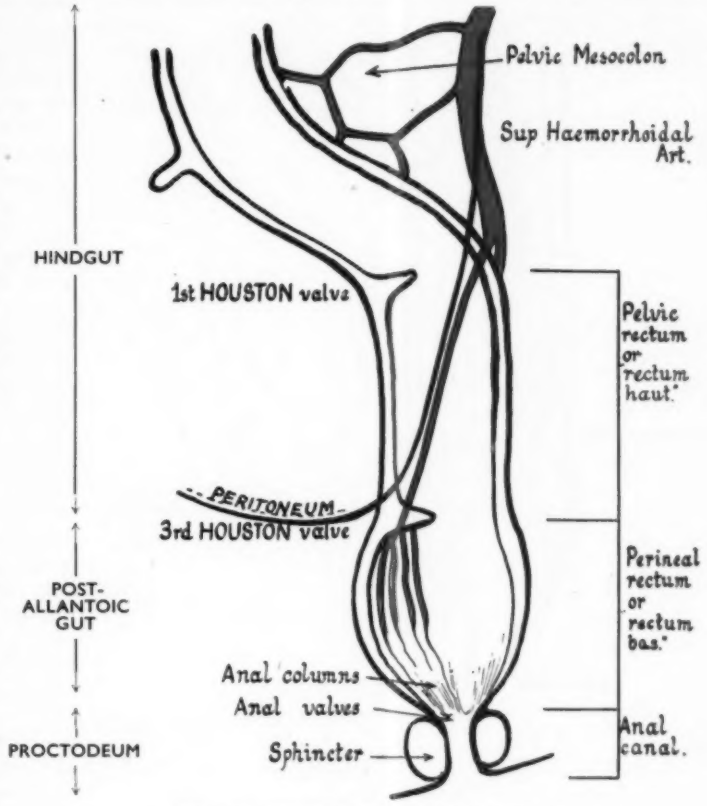

FIG. 695.—The subdivisions of the rectum.

Because of their separate embryological development and because of their quite distinctive anatomical features, Wood-Jones was convinced that the two portions of the rectum are morphologically distinct and worthy of being considered quite separately: the rectum should be described, in fact, not as a single anatomical structure, but as two.

There was singularly little reference to this introductory paper in the long discussion that followed and I have come across only a few references to it in the literature since.

In 1925 (Villemin and others), however, there appeared a communication from a team of French workers on the lymphatic drainage of the rectum which seems to me to do much to support and to confirm Wood-Jones's conception of the two distinct portions of the rectum.

Before going on to consider this work in some detail, however, I propose to summarize the classical description of the lymphatic drainage of the distal colon as elaborated by Poirier, Cuneo, and Delamere

(1903) at the beginning of the century, using Gerota's prussian blue injection technique.

They taught that there exist two extensive lymphatic networks in the rectum and anal canal, one in the muscular coat and one in the skin and mucous membrane. This latter consists of three parts :—

1. That of the skin close to the anal orifice.
2. The skin-lined segment of the anus itself limited above by the white line of Hilton.
3. The anal and rectal mucous membrane.

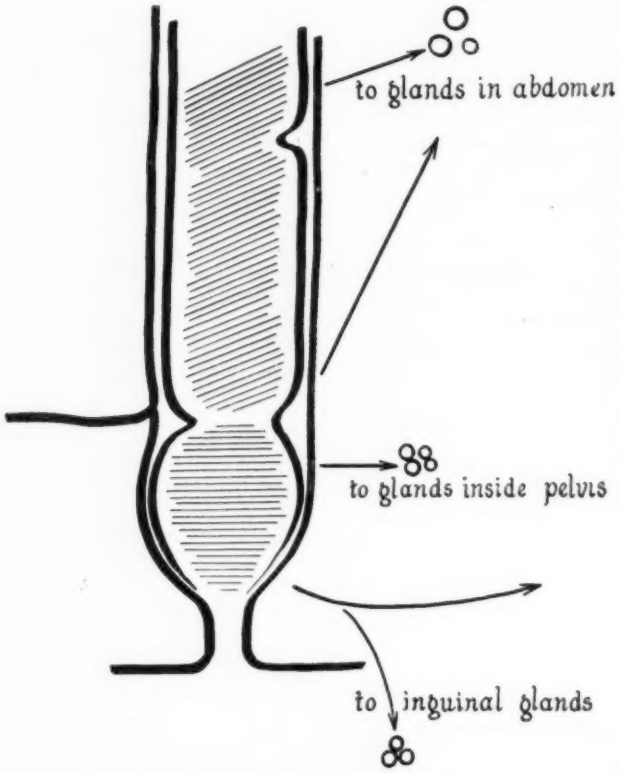

FIG. 696.—Diagram to illustrate the lymphatic watershed at the level of the peritoneal reflection and the direction of the main pathways of the lymph-drainage. (*After Villemin, Huard, and Montagné.*)

The lymph-channels from the first zone they found to drain into the inguinal group of glands. When the dye was injected into the second area, it was found to spread either up in the rectal columns (of Morgagni) into the network of the third area, or through the wall of the rectum to the pararectal, hypogastric, external iliac, and lateral sacral glands. From the third area (and this is the really important point as far as our present discussion is concerned) comprising the mucosa of the upper part of the anal canal and of the rectum, the lymph-drainage was directed to the pararectal glands (of Gerota) lying on the muscle coat, and thence through the glands of the mesorectum to those along the upper vascular pedicle.

The really important feature of the normal lymph-drainage as revealed by this dye injection technique is the very long length of bowel which was found to drain only upwards. Further, the level of the peritoneal reflection was not apparently found to be of any particular significance in relation to the position of the main lymphatic watersheds.

Let us now turn to the more recent work of Villemin and his colleagues (1925). Their primary object was to investigate the lymphatic drainage of the normal rectum as a guide to the proper understanding of the surgical pathology of the lymphatic spread of rectal cancer. Their studies were made in the full-term fœtus, the lymphatic system being outlined by injecting a variety of dyestuffs. When two dyes of differing colour were injected simultaneously at different levels, overlap and intercommunication of the lymph-drainage system was indicated by the staining of the collecting glands in a variety of intermediate hues.

In the pelvic colon they found a very freely anastomosing lymph-plexus which was not sharply demarcated below from the rather less abundant channels in the upper part of the rectum. They were surprised, however, to find that the lymph-plexus in the upper and in the lower parts of the rectum seemed to be quite distinct. Injections both from above and from below showed little sign of penetration into the other segment and simultaneous injection did not produce a boundary zone of colour mixing. The boundary line between the two constantly corresponded to the peritoneal reflection and to the third of Houston's valves (*Fig.* 696). The upper segment of rectum thus delineated they called " le rectum haut " or, what seems to me a particularly apt choice of phrase, " le rectum colique ", indicating thereby that this segment both in its structure, in its anatomical relations, and probably, too, in its function resembles the bowel above, rather than the remainder of the rectum below the peritoneal reflection. To this latter, which Wood-Jones had already called the ' new ' or ' perineal rectum ', Villemin referred as " le rectum bas ".

And further, not only did they demonstrate this striking division of the intramural lymph-plexuses, but they were able to show a fundamental difference in the direction of the lymph-drainage from the lymphatic network of these two distinct segments of rectum. When the dyestuff was injected into the perineal segment of the rectum (i.e., below the peritoneal reflection) it was seen to pass in three directions corresponding in the main with the zones of spread of rectal cancer described by Miles (1944) —viz., downwards, laterally, and upwards. The dyestuff when injected anywhere in the rectum below the level of the reflection passed in varying amounts in all three directions: its lymphatic connexions seemed to be both free and far flung. In contrast to this finding, when the dye was injected into the pelvic segment it was found to pass in one direction only—namely, upwards into the abdomen—sharing, above, the same channels which serve the ascending lymphatics from the perineal segment and negotiating a relatively narrow bottle-neck in the tissues around the inferior mesenteric artery.

These findings of Villemin confirm those of Delamere, Poirier, and Cuneo (1903), that the lymphatic drainage of the upper part of the normal rectum is predominantly along the line of the superior vascular pedicle. They differ, however, in that the lower limit of the selective upward drainage is placed

by them at the level of the peritoneal reflection and not as the earlier workers had suggested very much lower down at the anal intermuscular septum. What is even more significant is the sharp watershed at the peritoneal reflection with very little sign of freely anastomosing channels between the lymphatic network of the upper end of the lower parts of the rectum.

If this description of the lymph-drainage is a true one, then we can anticipate fundamental differences in the direction of the lymph-spread of cancer at different levels in the rectum. It may well be that the arrangement in the full-term fœtus does not truly represent its disposition in later life (developmental readjustments in the blood vascular system after birth are almost a commonplace) and just because in the fœtal cadaver freely-flowing dyes pass selectively in one direction, one cannot safely presume that growing cancer cells, as emboli or as a solid core of permeation, will act in the same way.

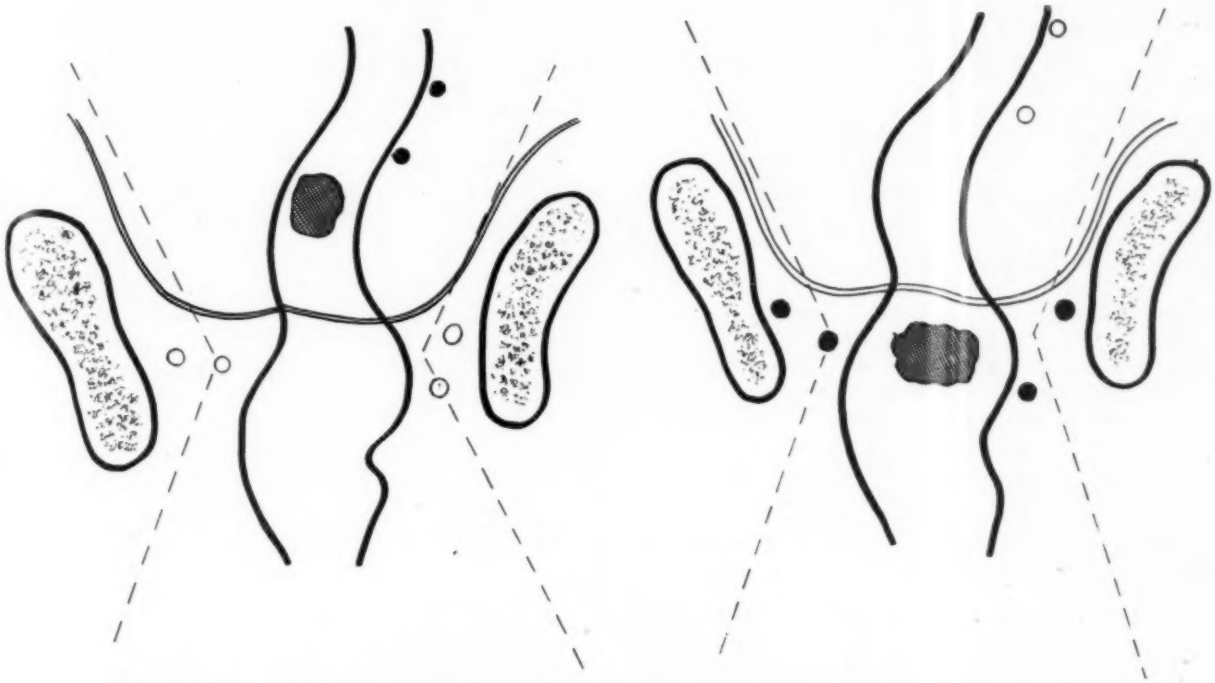

FIG. 697.—Diagrams to illustrate how the same operation, while adequate for the resection of a high tumour, may fail to eradicate an extraperitoneal growth.

However, there is already some evidence that the prognosis in rectal cancer depends to a significant degree on the position of the tumour in relation to the peritoneal reflection.

Gilchrist and David (1947), for example, who speak with the authority of a very long and very thorough experience of the clinico-pathological features of rectal cancer, found a strikingly high incidence of local and of liver recurrence in lesions below, in contrast to those above, the reflection. The recurrence rates in two comparable groups of patients were 43·5 per cent and 18·1 per cent respectively.

Equally significant figures have recently been published by Pfeiffer and Miller (1950) which seem to indicate a distinctly unfavourable prognosis when the tumour lies below the peritoneal reflection.

The worse prognosis of lesions below the peritoneal reflection could be explained in a variety of ways :—

1. It is probable that the higher lesions occurring in a less spacious portion of the bowel, give rise earlier to obstructive symptoms and come to operation at a correspondingly earlier stage.

2. It is one's impression that the peritoneum for long acts as a limiting investing layer and that even when the disease has spread to tissues outside the bowel these extensions can still be clearly demonstrated at operation. They also tend to involve organs which are reasonably accessible and which can safely be sacrificed.

3. On the other hand, lesions below the peritoneal reflection, not being contained by a serous coat, spread early, widely, and diffusely in the soft tissues of the pelvic cavity, often to involve structures which cannot readily be resected. Neither is it easy at operation in such cases to decide either the direction or extent of such local extensions. There is at this level, too, an increased likelihood of laterally directed lymphatic dissemination to areas more difficult to include in the scope of the resection.

4. Knowing that free local extension of the disease may occur more frequently in the case of tumours below the peritoneal reflection, and realizing, too, that lateral extension by the lymph-system is more likely, we would admit that it is at this level that we should be most insistent on the widest possible resection. In my experience, however, it is in the growths below the peritoneal reflection that I am most conscious of the disturbingly restricted extent of my resection, whether done from above or from below, in just the very situation where the site of the tumour most requires of me the

widest removal. The 'thinnest' part of what may be a satisfyingly 'long' operation specimen certainly seems often to be near the tumour itself (*Fig.* 697).

5. The prognosis in rectal cancer varies inversely as the incidence of microscopical evidence of vein invasion. Sunderland (1949), in a recent study of a large number of specimens of rectal cancer, found this occurring in a significantly higher percentage in lesions below than in those above the peritoneal reflection, a finding which was not surprisingly associated with a proportionately less propitious outlook. This happening he was inclined to attribute (somewhat unconvincingly, I thought) to the very large number of venous channels in the hæmorrhoidal plexus in the submucosa of the distal rectum.

The importance of the peritoneal reflection in relation to the prognosis in rectal cancer has not been universally admitted. It may be that analysis of a large amount of pathological material may fail to substantiate it. Kirklin and his colleagues (1949), for example, from a critical analysis of operation specimens at the Mayo Clinic, believe that the number of other factors affecting the prognosis is very large and are not satisfied that any differences in prognosis can be related specifically to this feature alone. In other words, a low tumour has a bad prognosis for reasons other than its happening to lie extraperitoneally. However, even while admitting that the argument is by no means cast-iron, it still seems to me to be reasonable to advocate the wide adoption of the level of the peritoneal reflection in descriptive anatomy of the rectum.

CONCLUSIONS

From a consideration of the anatomy of the rectum I wish to make the following points :—

1. For purposes of exact documentation, and especially for accurate comparison, it is essential that in discussing the management of a rectal tumour its exact position in the bowel must be clearly stated.

2. Although there are certain changes in the structure of the bowel at the sigmoid-rectum junction, the position of this level as determined by several observers may vary widely.

3. Measurements in relation to bony points are too uncertain to be of any real value.

4. The distance as measured from the anal orifice (which is in any case often an ill-defined starting point) may vary from one day to the next and even when measured in the resected specimen is subject to considerable variation.

5. One of the easiest landmarks for the surgeon and for the pathologist to recognize is the peritoneal reflection. It is admitted that its distance from the anal margin varies considerably from one patient to the next (and especially in the two sexes and in differing age groups).

6. Not only is the peritoneal reflection an easily recognizable landmark but there is evidence that the rectum above this level embryologically, morphologically, and possibly functionally, is quite distinct from the part below.

7. There is also some evidence that the reflection also marks the position in the normal subject of a very definite lymphatic watershed, the lymph above the level draining only upwards, and that below, not only upwards but laterally and downwards as well. There is a considerable body of evidence, too, that at least in the earlier stages of the disease, the spread of rectal cancer by the lymph-stream is in precisely the same direction.

8. There is already accumulating evidence that the prognosis following the resection of a tumour below the reflection is much less favourable than that of one lying above. This would be a good reason why we should always practise, for tumours below the reflection, the very widest resection.

9. The most radical resection of extraperitoneal tumours (commonly by a combined abdomino-perineal resection) is not only justified by a pathological argument but also from consideration of the technical problems involved (for example, in any sphincter-saving operation) it would be wise for us to consider the rectum above and the rectum below the peritoneal reflection as being fundamentally distinct.

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EPITHELIAL SURVIVAL AFTER CUTIS GRAFTING

By N. O. K. GIBBON and K. R. LOTHIAN

FROM WALTON HOSPITAL, LIVERPOOL

Cutis grafts have been used successfully in the repair of tissue defects for nearly forty years, without achieving general popularity. The theoretical risk of epidermoid cyst formation has probably been responsible for much prejudice, despite the continued absence of this complication in practice.

Rehn, who introduced the cutis graft in 1914, used it at first in the repair of large post-operative herniæ, and later in the reconstruction of various ligaments and tendons. The material was taken from the outer side of the thigh, after removal of a Thiersch graft to minimize infection and to provide a fresh bleeding surface. The graft was stitched to the edges of the defect under tension, which was regarded as the essential stimulus to incorporation of the cutis in the surrounding tissues. No cysts have been reported in Rehn's cases, and Uihlein (1939), using the same technique, found no epithelial elements in biopsies taken four years after cutis repairs.

The fate of human cutis grafts implanted subcutaneously *without* tension has been described by Peer and Paddock (1937). They found that removal of the epidermis had usually been incomplete, and that epidermoid cysts resulted. These cysts, however, were microscopic in size, and no epidermal epithelium remained at the end of twelve months. Sebaceous glands and hair follicles survived for only a few weeks, and, while sweat-glands were still to be found at the end of twelve months, they had undergone degenerative changes.

Mair (1945; 1946) used implants of whole skin in the repair of herniæ. The grafts were inserted under tension, and no cysts developed. In one case, biopsy after three months showed no sign of epidermal elements.

At this stage, it appeared that the risk of epithelial survival could safely be ignored. However, there has been recently a less reassuring report by Dumont and Van der Ghinst (1949), who found the whole-skin graft covered with sebaceous material and hair in two cases operated on for recurrent hernia.

The two cases now to be related are further examples of epithelial survival following cutis grafting, and, so far as we are aware, they are the first recorded instances of gross cyst formation, apart from the case reported at a pathological meeting of the Section of Surgery of the Royal Society of Medicine by Ewing (1950).

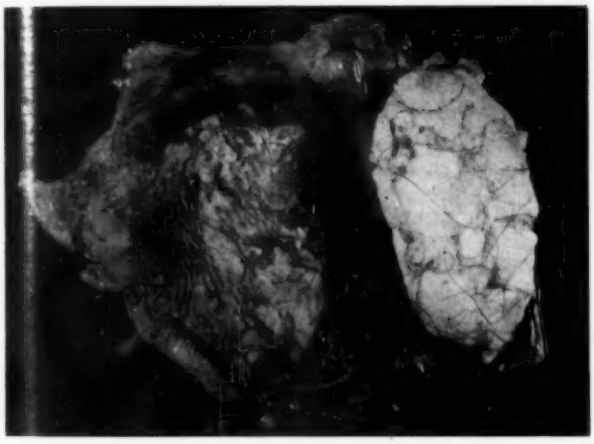
Cyst wall continuous with whole-skin graft
Mass of sebaceous material and hairs
Outline of whole-skin graft with growing hairs
Area sectioned

FIG. 698.—*Case* 2. Photograph of opened specimen, together with explanatory diagram.

The specimen in Ewing's case comprised (personal communication) two separate cysts, each partially lined by keratinized squamous epithelium, but without hair or sebaceous material. These cysts had arisen at the site of a whole-skin graft, which had been inserted under tension nine months previously in the repair of a large incisional hernia. Since this paper was submitted for publication, M. R. Ewing's case has been reported in detail (Powell and Ewing, 1952). Other examples of gross cyst formation following cutis grafting have also been recorded (Strahan, 1951: Clarke, 1952).

CASE REPORTS

Case 1.—A male, aged 65, underwent a cutis graft repair of his right inguinal hernia in September, 1948. The graft was taken from the site of the inguinal incision, and, without removal of the epidermis, it was sutured in position under extreme tension, using nylon.

He had no trouble, except that he occasionally noticed a lump under the scar, until November, 1949. At this time, whilst in hospital suffering from an unrelated condition, he developed a painful swelling in the right groin. There was an ovoid mass 5 × 2 cm. just under the old scar. It was irreducible and tender. Exploration showed much fibrosis under the scar, and at the outer limit of the inguinal canal was encountered a cyst from which white fluid escaped, together with some caseous material and many dark hairs. The cavity so entered passed behind the spermatic cord downwards and inwards to the os

pubis. The posterior wall of the canal was intact and firm except in the region of the internal abdominal ring. As there was obviously considerable infection present, no attempt was made to excise the cyst-wall and the cavity was drained. It was thought that a radical operation would be required later. However, the wound healed well, and up to the present time there has been no sign of recurrence.

Case 2.—A man, aged 46, had his right inguinal hernia repaired by insertion of a whole-skin graft in February, 1948. The graft, taken from the site of the inguinal

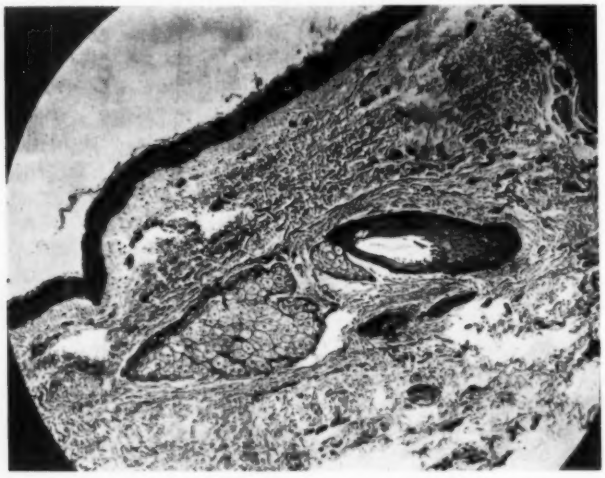

FIG. 699.—*Case* 2. Microphotograph of section from specimen. The area sectioned is shown in the diagram accompanying *Fig.* 698. (× 45.)

incision, was fixed in position under maximum tension, using fine nylon sutures.

In September, 1949, the patient noticed a painless lump under his inguinal scar, and in March, 1950, he was referred for treatment. There was an ovoid cystic swelling about 7 × 3·5 cm. within the inguinal canal, and moderate transillumination was possible. A hydrocele of the cord was diagnosed, but at operation the cyst was readily separable from the cord and surrounding structures, its origin becoming obvious as soon as it had been opened. It had a smooth lining, and on the inside of its posterior wall could be seen the outline of the original skin implant (*Fig.* 698), which was covered with a layer of sebaceous material, and from which hairs were growing. Apart from some clear fluid, the contents consisted, as shown in the photograph, of a mass of sebaceous material and hairs.

The posterior wall of the canal appeared to be strong, except in the region of the internal ring, which required to be narrowed.

A section of the cyst wall, across the margin of the original implant, is shown in the microphotograph (*Fig.* 699). A hair follicle and a sebaceous gland can be seen in addition to the squamous epithelium. There were many sweat-glands in other parts of the section. The absence of dermal papillæ may be taken to indicate that the original epidermis did not survive in the area sectioned (Hesse, 1912).

DISCUSSION

The two cases reported here indicate that epithelial survival and even gross cyst formation must be accepted, after all, as possible complications of whole-skin implants. It is unlikely that this risk will be eliminated by attempts to remove the epidermis from the graft, since such a procedure is often incompletely successful (Peer and Paddock, 1937), and since the hair follicles and sebaceous glands in the dermis are themselves capable of survival.

We do not suggest that cutis grafting be abandoned on account of what is evidently an uncommon complication, but we believe that it should be avoided if other procedures of equal efficacy are available for the purpose.

SUMMARY

The question of epithelial survival after cutis grafting is briefly discussed.

The two cases described illustrate that this risk of epithelial survival is not merely a theoretical one. In both of these cases gross cyst formation occurred, with survival of hair follicles and sebaceous and sweat glands.

It is suggested that cutis grafting be reserved for those cases in which its use carries unique advantages.

We wish to thank Mr. Lee, of the Central Photographic Department of the University of Liverpool, for the photographs.

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COMBINED CERVICO-BUCCAL PARTIAL PHARYNGECTOMY FOR CANCER OF THE OROPHARYNX

By RONALD W. RAVEN, O.B.E.

SURGEON TO WESTMINSTER (GORDON) HOSPITAL; SURGEON TO THE ROYAL CANCER HOSPITAL

AN operation is described for cancer of the lateral wall of the oropharynx which involved the tonsil, fauces, soft palate, and base of the tongue; metastases were also present in the upper deep cervical lymph-nodes. It was performed in July, 1949, and the patient is well without recurrent disease and at work. A record of the procedure is made because it may prove of value for other patients who are in a similar difficult situation, and, as far as the writer is aware, this is the first occasion such an operation has been successfully performed. The treatment of this type of cancer presents difficulties, and the end-results leave much to be desired. There are certain patients with lesions similar to that described in the case report which the radiotherapist is very reluctant to treat with irradiation techniques, so the surgeon is bound to conceive a bold plan of action in order to save the patient from being considered untreatable.

The surgical procedures designed to destroy the malignant tissue in situ by means of diathermy coagulation are unsatisfactory for the following reasons: It cannot be certain that total ablation of the disease is achieved, and the surgeon is diffident about penetrating too far into the pharyngeal wall in this particular region because of the close proximity of the internal carotid artery and the risk of severe hæmorrhage if this is injured by the diathermy knife.

Contemplation of this situation encourages the surgeon to perform a radical operation which conforms to the principle of cancer surgery that the primary disease must be widely excised together with the lymphatic vessels and regional lymph-nodes, if possible, in continuity. The operation described is radical because of the combined cervico-buccal approach, and in addition the lymphatic vessels and deep cervical lymph-nodes can be removed in continuity. In addition, the deformity afterwards is minimal and pharyngeal function is good. In planning this operation it was realized that excision of part of the mandible might be required if malignant invasion were found on exploration. The reconstruction of the oropharynx was also considered and several methods were designed to meet certain requirements.

CASE REPORT

A male, aged 62, was seen, in consultation with Mr. N. Asherson, with a carcinoma of the oropharynx.

HISTORY.—Four months previously he noticed a swelling in his mouth and another in the upper part of the left side of his neck. Two months before slight bleeding occurred from the mouth. One month before he experienced discomfort on swallowing.

ON EXAMINATION.—His general condition is satisfactory. *Oropharynx*: An ulcerating carcinoma is present in the left side involving the tonsil, both pillars of the fauces, and extending on to the soft palate and downwards to the left side of the base of the tongue. The carcinoma is fixed in the wall of the pharynx. *Neck*: The upper deep cervical lymph-nodes on the left side are enlarged, hard, and mobile.

OPERATION (July 22, 1949).—Combined cervico-buccal partial pharyngectomy and radical lymphatic block dissection of neck, left side. Reconstruction of the oropharynx.

RESULT.—The patient made an uninterrupted recovery. The wounds healed by first intention without leakage from the pharynx. He was examined on Jan. 23, 1952, and no sign of carcinoma was found. His general condition was good, wounds soundly healed; he is swallowing and talking well, and is at work.

FIG. 700.—Combined cervico-buccal partial pharyngectomy for carcinoma of the oropharynx. Extent of the reflection of the skin-flaps is shown. The block dissection of the cervical lymph-nodes has been completed (for the sake of clarity they are removed from the diagram). The oropharynx, upper part of the hypopharynx, and lower part of the nasopharynx have been mobilized. The carotid arteries are retracted away from the pharyngeal wall.

HISTOLOGY OF TISSUES REMOVED.—Epidermoid carcinoma of tonsil; carcinoma metastases in cervical lymph-nodes.

TECHNIQUE OF THE OPERATION

The patient is placed on the operation table with the head fully extended and rotated to the opposite side.

Anæsthesia.—Induction is carried out with intravenous pentothal-sodium; this is followed by cyclopropane administered by the endotracheal

route. The hypopharynx is packed with a roll of gauze to prevent blood entering the larynx.

Approach.—This is by a combined cervico-buccal route. The cervical part of the operation is performed first.

The Cervical Stage.—

Skin incision: This commences on the side of the lesion at the tip of the mastoid process and

FIG. 701.—The buccal stage of the operation. The mouth is opened widely and the extent of the incision through the wall of the pharynx is shown by a dotted line.

curves forwards 1 in. below the angle of the mandible to the midline 1 in. below the symphysis menti. It then passes down the midline of the neck to ½ in. above

FIG. 703.—Photograph of interior of patient's mouth, to show healed oropharynx, left side.

the suprasternal notch and outwards above the clavicle to the posterior border of the sternomastoid muscle.

Reflection of flaps: The posterior flap is reflected off the platysma muscle and is lifted as far back as the anterior border of the trapezius muscle. The upper flap is reflected upwards to expose the outer aspect of the mandible and the lower part of the parotid salivary gland.

Block dissection of neck lymphatics: This standard procedure is next performed and the following

FIG. 702.—The pharynx and neck have been reconstructed. Note that a portion of the posterior skin-flap is sutured to the prevertebral fascia on the posterolateral aspect of the pharynx. A small gap is produced, lined with skin, for drainage if leakage from the pharynx occurs.

structures are removed—the platysma muscle and the deep fascia from the midline to the anterior border of the trapezius muscle, the sternomastoid, omohyoid, posterior belly of the digastric and stylohyoid muscles; internal jugular vein, upper and lower groups of the deep cervical nodes, and the retropharyngeal lymph-nodes, taking care to remove the highest nodes in relation to the base of the skull. When the upper deep cervical group is involved they are excised in continuity with the wall of the pharynx.

Mobilization of the pharynx: The oropharynx on the side of the lesion is mobilized laterally and posteriorly by the following technique. The posterior belly of the digastric, stylohyoid, and stylopharyngeus muscles are removed, the carotid sheath is identified, and the carotid arteries are retracted laterally. The hypoglossal, glossopharyngeal, and facial nerves are preserved; the ascending pharyngeal artery is ligated and divided; the oropharynx is freed from the inner aspect of the mandible and separated from the prevertebral fascia and muscles posteriorly as high as a point well above the upper border of the carcinoma, which can now be palpated through the pharynx. The fibres of the superior constrictor muscle of the pharynx which arise from the pterygoid plate are divided. (*Fig.* 700.)

The Buccal Stage.—The mouth is widely opened with a gag and the precise limits of the carcinoma are determined. An incision is made around the lesion at least 1 in. distant from its edge with the diathermy knife. This incision is deepened through all the structures of the pharyngeal wall, the internal

carotid artery being held aside in the neck. (*Fig.* 701.) The growth is then delivered into the cervical wound. Hæmostasis is secured by diathermy coagulation and the mucous membrane of the oropharynx is repaired by interrupted sutures of fine catgut. This concludes the intra-buccal operation. The gag is removed and the mouth closed.

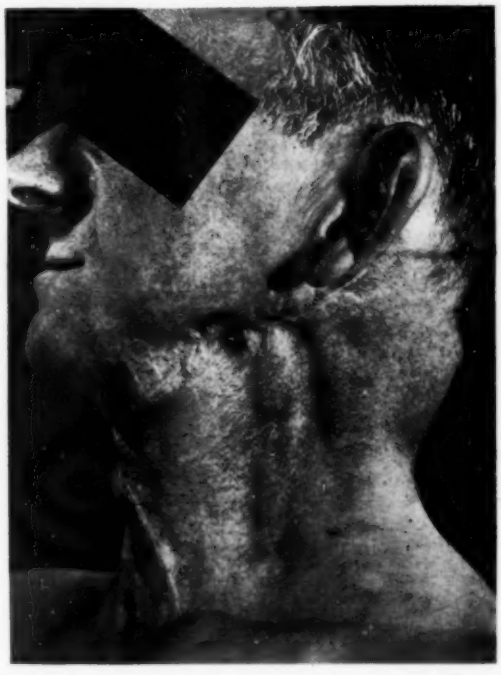

FIG. 704.—Photograph of patient's neck to show healed wound.

The Cervical Operation continued.—The carcinoma is removed in continuity with its lymphatics—the retropharyngeal, upper and lower deep cervical lymph-nodes.

Reconstruction of the Pharynx and Neck.—The pharynx is closed by suturing the muscles of the pharynx with interrupted sutures of silk and reinforced by using fibromuscular tissue in the vicinity.

In order to shut off the lateral compartment of the neck from mouth contamination the following technique is used: A portion of the upper border of the posterior skin-flap is sutured to the prevertebral fascia on the posterolateral aspect of the pharynx by several interrupted sutures of silk. The rest of the upper border is sutured to the margin of the upper skin-flap over the mandible. By this manœuvre a small gap is formed, lined with skin, through which drainage from the pharynx can occur if there is any leakage. The remainder of the wound in the neck is closed with drainage from its lower aspect. (*Figs.* 702–705.)

Feeding the Patient.—At the end of the operation a rubber œsophageal tube (No. 12) is passed from the mouth into the stomach, through which the patient is fed until swallowing is resumed.

After-care.—The patient's nutrition is maintained by œsophageal tube-feeding for one week, when fluids can be given by mouth. This is increased gradually through the semi-solid food stage until normal food can be taken. Routine treatment is given to the neck wound and the tube is removed after forty-eight hours. Mouth-washes are used frequently.

FIG. 705.—Radiograph showing the outline of the pharynx when swallowing barium.

Systemic penicillin therapy is continued for four days after the operation. Breathing exercises are performed and early ambulation is instituted.

SUMMARY

A combined cervico-buccal operation has been designed and performed successfully for a carcinoma involving the structures of the lateral wall of the oropharynx, including the tonsil, fauces, soft palate, and base of the tongue. Metastases were present in the cervical lymph-nodes. The case report of the patient is presented, showing that he is well and at work 2½ years after the operation. This lesion was unsuitable for irradiation treatment, and it is felt that the radical surgical operation described is a valuable method in the management of these difficult lesions.

Addendum: Since this paper was written another patient with a similar carcinoma has been successfully operated on. He is well five months later.

I wish to thank Mr. N. Asherson for his valuable help in these problems and for assisting me with the operation. The excellent nursing care of the patient by Miss M. V. Frankland and her staff at the Royal National Throat, Nose, and Ear Hospital is gratefully acknowledged.

RETROPERITONEAL PELVIC LEIOMYOSARCOMA

By L. B. FRATKIN, I. W. STOFFMAN, and E. LANDA, Vancouver, B.C., Canada

Retroperitoneal tumours occur fairly frequently, but a leiomyosarcoma is unusual, and the following case report is added to the meagre list, pointing out the difficulties in diagnosis and treatment. (Ewing, 1940; Golden and Stout, 1941; Phillips, 1934; Magoun, 1919; and Newman, 1950.)

CASE REPORT

Mr. J. A. H., aged 76 (*b.* July 15, 1873), was admitted to the Vancouver General Hospital (G38637) on July 26, 1949, complaining of pain in the lower abdomen with inability to pass urine. Examination showed a large palpable mass in the left iliac fossa, with displacement of the bladder to the right. The admission diagnosis was carcinoma of the rectosigmoid. Catheterization was done (I. W. S.) and 7 oz. urine was drawn with relief.

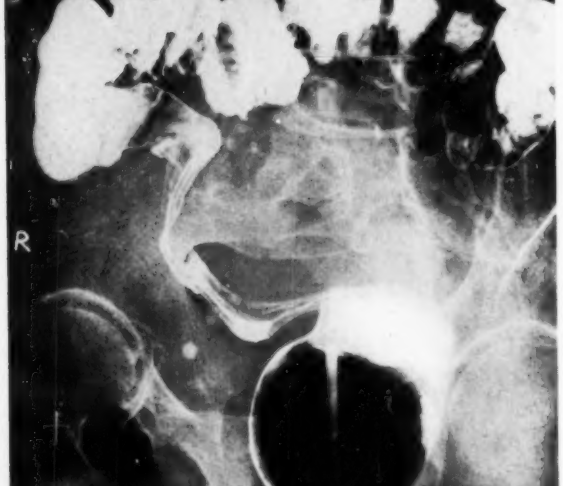

Fig. 706.—Barium enema; anteroposterior view showing displacement of rectum and sigmoid to the right. A few diverticulæ are also noted.

Fig. 707.—Barium enema; lateral view, showing displacement of the rectum and sigmoid anteriorly.

Further history obtained: A feeling of heaviness in the pelvis with alternating constipation and diarrhœa of one month's duration and a slight loss of weight. There was some frequency but no hæmaturia. Essentially the course was painless until the day of admission.

On Examination.—A tall, rather emaciated looking male, lying in bed in no discomfort. His blood-pressure was 160 mm. systolic, 90 mm. diastolic. Electrocardiogram showed some myocardial changes with depressed T_1. The abdomen moved with respiration. There was a bulging of the lower right abdomen with a soft, ovoid mass that was dull to percussion, extending from the symphysis pubis up to the right, which disappeared on catheterization. In the left lower quadrant there was a large, rounded, relatively smooth mass about 4 in. in diameter that was questionably movable, non-tender except on heavy palpation, non-pulsating, and without a bruit. The external iliac pulsation was easily felt and was displaced upwards and laterally. Bowel sounds were audible and considered normal. The liver edge was smooth, sharp, and palpable 2 cm. below the costal margin. A few soft, freely movable, non-tender, inguinal lymph-nodes were felt in the left groin, but none elsewhere.

Rectal examination showed large prolapsed hæmorrhoids at the right anterior and posterior poles, with loss of subcutaneous fat in the perianal tissues. On the left side a mass was felt that appeared to be ballottable on bimanual palpation, and it was considered the mass was extrarectal. The prostate was small, firm, and not unduly enlarged, and seemed to be separate from the mass, which was situated behind the rectum, and displacing it ventrally and to the right. Sigmoidoscopic examination was possible to the rectosigmoid junction (15 cm.) and showed anterior and right displacement of the rectum and a benign looking, small pedunculated polyp at the level of the upper valve of Houston.

Barium enema (Dr. W. Boyd) (*Figs.* 706, 707) showed displacement of the rectum and sigmoid anteriorly and to the right by a soft-tissue mass free of calcification. Numerous diverticulæ and some evidence of diverticulitis was noted in the sigmoid and transverse colon. Intravenous pyelography (*Fig.* 708) showed normal filling on the right side, whereas on the left side one could not make out the outline of the left kidney nor was there any function on that side. Chest radiograph was negative.

Laboratory investigation showed a red blood-count of 4,200,000; hæmoglobin 10 g. (75 per cent); colour index 0·9; white blood-cells 10,000, with normal differential; sedimentation rate 17 mm. per hour (Westegren); stool occult blood negative. Urinalysis: *p*H 6·0; clear; specific gravity 1·007; pus cells plus 2, and hyaline casts. T.P.R. 99° F., 70, 20. Kahn negative.

Progress in Hospital: On Aug. 4 a cystoscopy was attempted (E. L.) and it was found that the patient had

a posterior urethral stricture and a large adenomatous prostate which prevented retrograde pyelographic study. Owing to the manipulation a catheter could not be introduced and an emergency suprapubic cystotomy was done. The bladder was thick-walled and œdematous. The left ureteral orifice was found and a catheter was introduced into the left ureter, passing up 3 cm. only, when it ran into the mass which was partially exposed. An aspiration biopsy of the tumour was done and from the gross appearance, and the findings to date, it appeared that the likely diagnosis was a hypernephroma in an ectopic kidney, or a retroperitoneal sarcoma. The biopsy (S49-5635) showed no tumour tissue. Four days later a retrograde pyelogram was done and it showed the ureter coiled up in what appeared to be a short dilated ureter of a pelvic kidney (?).

On Aug. 16 an extraperitoneal exposure of the mass was performed (L. B. F.) through a left oblique muscle-cutting incision. The external iliac vessels were found to pass over the pelvic tumour with flattening of the iliac vein. No thrombosis was demonstrated. The tumour mass was lobulated, extremely vascular, and extended down into the hollow of the sacrum behind the rectum. It was firm, yellowish-red in colour, and seemed adherent to all the surrounding pelvic tissues, and attempt at removal had to be abandoned because of bleeding. There was no encapsulation of the tumour mass. A biopsy taken from the dome of the tumour (S49-5972) showed thick connective-tissue, large blood-vessels, and no tumour cells.

The tentative post-operative diagnosis was inoperable hypernephroma of a pelvic kidney.

Following his exploration the patient had a fairly good course, marred by a superficial wound infection that responded to antibiotics. In addition, he showed pitting œdema of the left leg, which was easily controlled by elevation of the limb.

On Aug. 29 a transurethral prostatic resection (E. L.) was done. At this time a cauliflower-like mass of tissue was seen protruding into the bladder neck but no specimen was obtained. Report of the prostate (S49-6316) showed an adenomatous prostatic hypertrophy.

Following these procedures the patient showed a loss of 7 lb. weight but no signs of cachexia. His hæmoglobin was 84 per cent and he appeared to be responding fairly well, but on Sept. 16 he bled per urethra and suprapubically, and so on Sept. 19 he had a further cystoscopy. Thereafter he did fairly well and managed to get up and about. By Sept. 23 his sedimentation rate was 82 mm. per hour (Westegren).

In view of his fair state it was decided to give him a course of roentgen-therapy, and a total tumour dose of 3480 r in nineteen days by four fields to the left pelvis was given (Dr. R. G. Moffat at B.C. Cancer Institute). No improvement was noted, nor was there any evidence of regression of the tumour mass. On Dec. 31 the patient was discharged home with the diagnosis of retroperitoneal pelvic tumour and a benign prostatic hypertrophy. His course at home was fairly good, but after a 24-hour episode of acute abdominal pain he expired on April 12, 1950, eight and a half months following admission.

AUTOPSY FINDINGS (A50-339. Performed by Dr. R. E. Beck, Department of Pathology, Vancouver General Hospital).—The body was that of a pale, thin, emaciated, elderly male showing no superficial lymphadenopathy or œdema. There was an oblique incision in the left lower quadrant which had healed, and a small healed suprapubic incision also present. Both legs were of normal size.

The thorax showed no significant pathological changes other than a moderate degree of pulmonary œdema and some aspiration of stomach contents seen in the trachea and bronchi. Associated with this was an early aspiration pneumonia involving the lower lobes. The peritoneal cavity contained approximately 1000 c.c. of greyish, foul-smelling, purulent material which occupied the dependent areas. The peritoneum had lost its normal lustre, though there was no fibrinous exudate on the visceral surfaces. The left side of the pelvis was occupied by a large tumour mass which measured 12 × 9 × 6 cm. This had displaced the lower sigmoid and rectum to the right side of the pelvis and had pushed the bladder anteriorly. It was covered with smooth peritoneum on its lateral and posterior surfaces, but anteriorly it was soft, necrotic, and appeared to be involving the posterior portion of the bladder wall. It could be removed from the pelvis without too much difficulty and on cut section

FIG. 708.—Intravenous pyelogram – showing normal filling on the right side, with slight dilatation of the ureter. On the left side there is no dye and the outline of the left kidney cannot be made out. A few scattered remnants of barium are still present in the diverticulæ of the transverse and sigmoid colon.

it was found to be very soft, whitish, and with soft grey necrotic areas scattered throughout. The necrosis was most marked in the anterior portion of the tumour, where it was involving the bladder. Throughout the cut surface could be seen many small, whorled, whitish areas which were circumscribed in nature. The tumour had not infiltrated the rectum or sigmoid. The bladder showed a blackish-green sloughing surface, and on its posterior aspect were found three small fistulæ which communicated with the necrotic portion of the tumour mass which lay behind the posterior wall of the bladder. The mucosa of the bladder did not show any obvious neoplastic involvement. It was felt that the above-mentioned fistulæ were the source of the peritonitis and that these had resulted from extrinsic involvement of the bladder wall by the retroperitoneal neoplasm. The right ureter appeared normal, but the left seemed to have been compressed by extrinsic pressure of the neoplasm, and on probing its lower end, several small white calculi were found obstructing it. The ureter above this point was dilated and contained pus. The left kidney was in its normal position, very soft and pale, the pelvis and calices were enlarged, and filled with purulent material similar to that seen in the ureter. The right kidney showed a few pitted scars on its surface. Its pelvis was slightly dilated, though not nearly to the degree noted in the left. Here, also, there was a small quantity of pus and several yellowish-white calculi. The prostate

was small and soft. There was no evidence of neoplasm or of infection. The spleen was slightly enlarged, weighing 330 g. It felt soft and showed evidence of a toxic splenitis. The other abdominal viscera showed no significant pathological features.

Histology.—Sections taken from the tumour revealed this to consist of elongated spindle cells arranged in whorls and interlacing fasciculi (*Fig.* 709). The tumour was moderately cellular and showed scattered areas of necrosis in various sections. The cells throughout were spindle-shaped, having a fairly rich eosinophilic cytoplasm and an elongated nucleus which in places showed the blunted ends suggestive of their being myocytes (*Fig.* 710). They appeared quite well differentiated, only an occasional bizarre cell being encountered. Mitoses were infrequent. The vascular channels within the tumour consisted of capillaries with flattened endothelial lining. No typically palisaded nuclei were found,

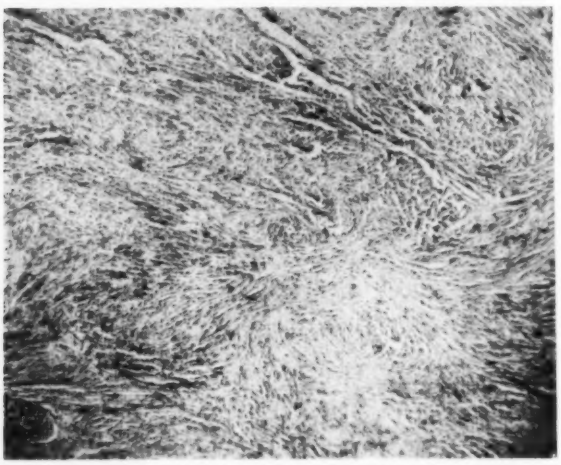

FIG. 709.—Section of tumour, showing spindle cells in whorls and interlacing fasciculi. (H. and E.) (× 30.)

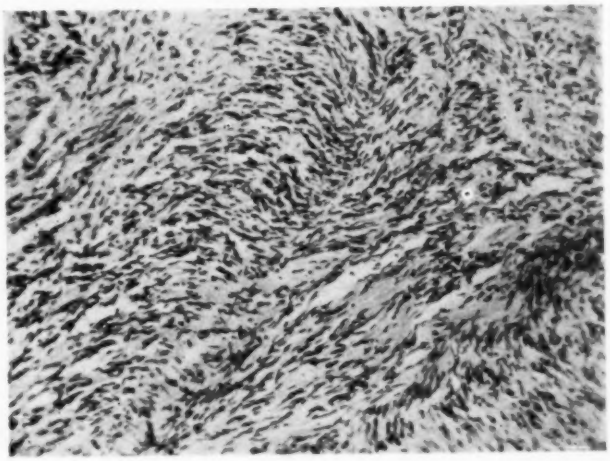

FIG. 710.—Section of tumour with spindle cells somewhat suggesting myocytes. (H. and E.) (× 112·5.)

and it was felt that the characters of the tumour were more those of a leiomyosarcoma of low-grade malignancy than a neurogenic sarcoma. Multiple sections were examined from both the prostate and bladder, and in none of these could the origin of the tumour be demonstrated. It was therefore concluded that the neoplasm had probably arisen in the retroperitoneal tissues. Sections of the kidneys confirmed the gross diagnosis of pyonephrosis, while in addition there were a few scattered scars of chronic pyelonephritis. None of the other tissue sections showed any significant pathological features, there being no metastases in any of the viscera or lymph-nodes.

DISCUSSION

A case is presented of a 76-year-old white male admitted to hospital for an acute urinary retention with the findings of a large retroperitoneal tumour mass in the left pelvis that was found to be displacing the pelvic structures to the right, and so intimately attached to the structures that extirpation was impossible. Direct extension of the tumour into the base of the bladder eventually led to the formation of fistulæ, with rupture into the general peritoneal cavity and final death from peritonitis and bronchopneumonia. This may, in part, have been the result of his prostatic resection. In addition, pressure on the left ureter resulted in a left pyonephrosis with failure of left renal function, thus confusing the picture on attempting to determine the nature of the pelvic tumour. The final diagnosis was leiomyosarcoma presumably arising from retroperitoneal tissue, as no origin could be made out from bladder, prostate, or bowel.

Leiomyoma and leiomyosarcoma occur most frequently in the uterus, alimentary canal, skin, heart, kidney, bladder, and prostate, and occasionally in the retroperitoneal tissues. Golden and Stout (1941), in a review of 60 smooth-muscle tumours, found only 8 located in the retroperitoneal tissues. They pointed out that it is impossible to decide before operation if a particular retroperitoneal tumour is of smooth-muscle origin. The essential symptoms and signs are those of the mass and the pressure effects produced by the mass. This may be manifest as: (1) pain due to pressure on nerves; (2) œdema of the legs; (3) occasionally ascites; (4) partial intestinal obstruction; and (5) interference with urinary function. The most consistent sign is a palpable indurated fixed mass, and there is little that is characteristic about the gross appearance of the tumour, though usually it is firm, rounded, and intimately attached to the surrounding tissues by innumerable large and small blood-vessels that bleed profusely on manipulation. The cut section shows some lobulation, with a greyish-red surface, and areas of softening or degeneration intermingled with firm, whitish, whorled tissue.

Microscopically the tumour is made up of interlacing smooth-muscle cells that are partially or incompletely differentiated, with varying palisade formation by elongated nuclei that show numerous mitoses in the more malignant variants. The amount of fibrous tissue stroma varies and large and small vessels are seen coursing through the tumour.

In Golden and Stout's series of 8 cases there were 6 females and 2 males. The youngest was 32 and the oldest 70, and the majority occurred in the sixth and seventh decades.

Metastases were present in 6 of their series and in only 2 were the lesions removed by operation. Biopsy alone was performed in 5 and 1 was diagnosed at autopsy. The duration of life following discovery varied from immediate post-operative death to a cas

that survived 5½ years following operation and 10½ years after the onset of symptoms. In their last case of a relatively benign tumour treated by radiation therapy the patient was symptomless and working 7½ years after diagnosis. It was noted that the tumour mass was smaller, and that the primary site of growth was into the mesentery of the ileum and ileocolic vessels. This variation in the life expectancy was due, then, in part to the location of the primary tumour, whether metastases had occurred, and the histological character of the tumour, and the overall picture is one of a highly lethal lesion.

Generally, the tumour when found is inoperable due to its very nature, and though morcellation of the tumour is advised by some, this is rarely feasible. In most instances biopsy alone is possible and the role of radiation therapy is undetermined, but should be tried in view of the results of Case 30 of Golden and Stout's series. In our case radiation therapy did not seem to produce much benefit.

We wish to thank the Departments of Radiology, Photography, and Pathology, Vancouver General Hospital, for their interest and co-operation in the management of this case.

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HERNIATED NUCLEUS PULPOSUS: THE FREE FRAGMENT

BY J. E. PATERSON AND W. GRAY, GLASGOW

IN 1911 Teacher and Middleton reported a case of herniation of an intervertebral disk at the level of the lumbar enlargement of the cord, with paraplegia and death on the sixteenth day. The onset was acute; a labourer aged 38 was lifting a heavy plate when he felt something crack in his back. There was very severe pain, but he was able to walk the short distance to his home, and it was not until nearly twenty-four hours later that he became completely paraplegic. He died of a urinary infection. The cord and its coverings were removed post mortem for later more detailed examination, when the cord was found to show a focus of softening with a segment which was "thinner than the rest and appeared crushed. "Opposite it, entangled in the loose fibrous tissue of the exterior of the dura mater, there was an irregular, roughly circular flat mass of firm white tissue which looked rather like the pulp in the centre of the intervertebral disks." That this was so was confirmed by microscopical examination. Unfortunately the fragment of disk was not noticed until the day after the post-mortem and the body could not then be examined, but it is noted that injury and displacement of the vertebræ of the common types had been searched for and could be excluded. It should be emphasized that the fragment of disk lay quite free in the spinal canal.

The authors remarked on the rarity of this type of injury and stated that they had been unable to find a record of an exactly similar case in the literature. To-day, thirty-nine years later, the volume of literature on herniation of the intervertebral disks has greatly increased and references to a similar lesion may easily be missed. In our review of the literature we have come across no such case of disk herniation at the cord level with a free fragment, nor have we encountered one personally. Much less uncommon, however, is the finding at operation of a fragment of disk material lying free in the spinal canal at a lower level, opposite the cauda equina. In this paper a series of such cases is reported, features which may sometimes differentiate them clinically from the more common types of disk lesion are indicated, and their recognition and treatment at operation are discussed.

Review of the Literature.—It is remarkable how few references to the 'free fragment' have been encountered in a fairly complete perusal of the literature. The condition is not unknown, but it does not appear to have received the attention it deserves. In 1929 Dandy published a paper entitled 'Loose Cartilage from an Intervertebral Disk simulating Tumour of the Spinal Cord'. Despite his use of the term 'free' to describe the type of protrusion, from the context it is doubtful if he really meant that the fragments were indeed entirely free from the parent disks. The illustration certainly does not show the fragment to be free. In a later paper Dandy (1942) referred to this earlier publication: "Only twice have I seen at operation actual spontaneous rupture of the posterior spinal ligament with freely-lying cartilage in the extradural space." By this time his experience had extended to cover a series of 300 cases of prolapsed disk.

A passing reference to the free fragment, which shows that they clearly recognized its occurrence, was made by Love and Walsh in 1943. Petit-Dutaillis in 1945 wrote: "The hernia may present itself under three types: a simple localized pushing backwards of the fibrous ring; hernia of the nucleus through an aperture in the fibrous ring; foreign body detached from the fibrous ring. The last variety, exceptional, has only been encountered twice . . ." His series consisted of 125 cases. Much more emphatic, however, were Peyton and Simmons (1947), who stated: ". . . out of 80 proven cases 29 showed disk material lying free in the epidural space." In the same year Kristoff and Odom (1947) laid considerable stress on the free fragment and classed it as one of six conditions which caused variation from the classical prolapsed disk syndrome.

CASE REPORTS

The cases to be described have been selected from a series of 91 patients who have been shown by operation to have disk lesions at the cauda equina level. Any basis of classification must be quite arbitrary; all gradations exist between a bulging, soft annulus at one end of the scale and a ragged mass of fibrocartilage lying free within the dura and giving the picture of a cauda equina tumour, at the other. Furthermore, the size of the protrusion varies independently of its anatomical relationships, and, particularly in the last two groups as defined below, all sizes, up to a very large, tumour-like mass, may occur.

For the purpose of this paper we have divided our series of cases into four groups according to the anatomical findings:—

Group 1: There is a bulging soft annulus without root pressure, usually associated with symptoms of lumbago. This type of lesion rarely comes to operation.

Group 2: The most common operative finding; a protrusion of the disk contents within a thinned-out annulus and posterior common ligament, with the classical signs and symptoms of sciatica of disk origin.

Group 3 (11 cases): The annulus is perforated and the protruded fragment lies, partly at least, between annulus and posterior common ligament. Some of these cases may be difficult to distinguish at operation from those of Group 4, since interference with the thinned-out posterior common ligament, as by the retraction of an adherent nerve-root, may produce further herniation by rupturing the ligament. In any case, such a distinction is of no practical surgical importance; the treatment in both cases is identical. Again, it is often difficult to determine whether complete rupture of the annulus has occurred, especially when the protrusion is a large one, since annulus and posterior common ligament are so stretched and fused together that their exact relationships to the protrusion cannot be made out. In some examples there is demonstrated at operation a small hole in the annulus and a 'collar-stud' protrusion of part of the fragment through it. According to the size of the protrusion, patients with such lesions may give the picture of either ordinary sciatica or cauda equina tumour.

Group 4 (8 cases): Herniation has been followed by complete separation of a portion of disk material and the separated fragment lies free in the spinal canal posterior to the common ligament, as a rule in the extradural space, but sometimes actually within the dura itself. It is this group of cases which is the subject of our paper.

It is difficult to know what best to call such separated pieces of disk material. There is an obvious objection to the term 'sequestrum', with its connotation of sepsis; and again, Kendall (1947) has used it already to denote what we have called the 'collar-stud' type. Here we have called it the 'free fragment', which is at least unambiguous. The following series of case reports have been arranged roughly according to the size of the separated fragment, beginning with those in which it is small and—an important practical point—may easily be missed at operation.

Case 1.—Jane K., 27 years; nurse. There had been a sudden onset of right-sided sciatic pain seven weeks before admission, curiously enough on awaking on the morning she was operated on for appendicitis. The pain was severe, and was aggravated by movement, coughing, and sneezing. There was no history whatever of injury or sudden strain. Some improvement occurred after three weeks' rest in bed, but she relapsed when she began to go about again. There was a right-sided Lasègue's sign at 45°, hypo-algesia of part of L.5 dermatome, right leg, and diminished right ankle-jerk, while extension of the lumbar spine was limited. Radiographs showed early osteo-arthritic changes in the lumbar spine, while myelography revealed a filling defect, compatible in its appearances with a disk hernia, at L.5/S.1 level.

AT OPERATION (1946).—The right side of the theca and S.1 nerve-root were exposed by the excision of the right ligamentum flavum and a small part of the lower edge of L.5 lamina—a 'keyhole' exposure of L.5/S.1 interspace. An aperture was seen in the posterior common ligament at the disk level and, just caudal to it, on the surface of the body of the first sacral vertebra, lay a fragment of disk material free in the canal. It was picked out, the aperture in the annulus was enlarged, and a quantity of fibrocartilage was extracted in pieces.

This case shows how a piece of disk material may be completely separated without any history of severe strain. The important feature in such cases is the finding at operation of a hole in the posterior common ligament *not made by the surgeon*. A free fragment must surely be present in such circumstances and should be searched for until found.

Case 2.—Reginald H., 44 years; pilot. There was a five years' history of low back pain with remissions, following an injury when his ship was bombed in 1940—he was pinned down by a piece of superstructure and lay in the water an hour and a half before he was rescued. He was off duty, first for a year, and thereafter for occasional periods, until three months before admission, when severe left sciatic pain, aggravated by coughing and at times associated with slight twinges in the right leg, came on. Lasègue's sign was positive at 30°, left side, and there was hypo-algesia of L.5 and S.1 dermatomes, left leg. Mobility of the lumbar spine was limited. Radiographs were negative; myelography was not carried out.

AT OPERATION (1945).—Keyhole exposure, L.4/L.5, left side. When the theca was retracted a fragment with the appearances of fibrocartilage was found lying loose in the extradural space. There was a gap in the annulus and posterior common ligament through which a director could be passed. Through this the degenerate interior of the disk was removed with spoon and punch forceps.

This case is very similar to *Case* 1. The short history of severe sciatica following years of low back pain suggests a degenerate disk lesion with sudden protrusion of a fragment three months before operation.

Case 3.—James McF., 50 years; credit supervisor. Intermittent attacks of low back pain had come on about a year before admission, to be followed in four months' time by constant left-sided sciatica. A plaster spica had been applied a month before admission, with some lessening of the pain, but a week before he felt something crack in his back when he turned round suddenly, and very severe pain came on in the back and radiating down the left leg. It was much more acute than ever before, and with it were a dull feeling and tingling in the foot. Lasègue's sign was positive at 40°, left side;

there was hypo-algesia of a portion of L.5 and S.1 dermatomes, left leg; the left ankle-jerk was absent. Myelography was not performed.

AT OPERATION (1949).—L.4/L.5 interspace, left side, was explored through the usual keyhole exposure. A craterlike perforation of the annulus, rather medially situated, was found; forceps was inserted and a piece of nucleus was extracted. L.5/S.1 space was then explored; when the theca and S.1 root were retracted a large piece of fibrocartilage was found lying ventral to the theca and picked out. L.4/L.5 disk was then thoroughly curetted.

In this patient, the most recent of the series, profiting by our experience, when the hole in L.4/L.5 annulus was disclosed we searched for and found the free fragment by exposing the intervertebral disk below; it had slipped down the whole breadth of the body of L.5. It is tempting to connect its extrusion with the sudden exacerbation of pain when the patient turned round abruptly seven days before admission.

Case 4.—A. H., 56 years; Army officer. About two years before admission he had sudden severe pain in the lumbar region radiating down the left sciatic distribution to the ankle. Improvement followed a month's rest in hospital, but the residual ache persisted and further attacks of acute sciatica occurred nineteen and eleven months before admission, one of them brought on by lifting a heavy kitbag. His last attack was four days before admission; it was more severe than the others, so severe that walking was impossible. There was numbness of the three lateral toes; Lasègue's sign was positive at 60° on the left side; hypo-algesia of portions of L.4, L.5, S.1, and S.2 dermatomes, left leg, present; the left ankle-jerk absent. Radiographs showed osteoarthritic lipping of L.3, L.4, L.5 vertebræ without any narrowing of the disk spaces. When myelography was performed L.5 root pocket was seen to be absent and S.1 root pocket displaced somewhat medially on the left side.

AT OPERATION (1945).—Keyhole exposure, L.4/L.5, left side. L.5 root was adherent to the annulus, and just at the extreme caudal limit of the field some rough, granular, fibrocartilaginous material could be seen beneath it. This suggested that a piece of disk material had burst through L.4/L.5 annulus, and after L.5/S.1 interspace had been explored with negative results a narrow hemilaminectomy of L.5 was carried out; when the dura was retracted two large pieces of fibrocartilage, lying quite free in the spinal canal beneath L.5 root, could be lifted out. The adhesions fixing L.5 root were then freed; some were so dense that they had to be cut with a knife. It was thought that the fragments had passed out through a hole in L.4/L.5 annulus, which had later become sealed by the adhesion of L.5 root over it.

The two free fragments might very readily have escaped detection. Here there was no opening in the annulus to arouse our suspicions, and we could quite easily have been satisfied from the discovery of the densely adherent root that we were dealing with an old, 'burnt-out' sciatica, especially since the myelographic appearances were unobtrusive. But against this was the clinical picture, which was very suggestive of gross cauda equina root pressure by a large protrusion. We feel we should have gone on to do a laminectomy even if the fragment had not shown itself through the first keyhole exposure. The dense adhesions of root to annulus suggest that the fragments must have lain free in the canal for a considerable time, perhaps ever since the first attack of pain—and it is tempting to relate the various relapses to shifts in their position—we may think of them as wandering about in the extradural space.

Case 5.—Mrs. D., 43 years; housewife. A short history. Five months before admission she felt a dull aching low back pain; there had been no noticeable strain or injury. Two weeks later severe twinges of pain in the left buttock came on and extended later down the whole length of the leg. A left-sided Lasègue's sign was positive at 60°; there were hypo-algesia, S.1 dermatome, and depression of ankle-jerk, left leg, with diminished range of extension of the lumbar spine. Myelography showed a filling defect, of the type characteristic of prolapsed disk, at L.5/S.1 level.

AT OPERATION (1945).—Keyhole exposure, L.5/S.1, left side. A large white mass of fibrocartilage was seen as soon as the ligamentum flavum was excised. It lay lateral to the theca and was readily delivered when pulled on by forceps. It seemed to represent the greater part of the disk interior. Several good-sized pieces of disk material were then picked out from within the annulus and the large hole in this structure was well displayed. Curetting gave no result whatever and S.1 root, displaced by the large free fragment, was never visible throughout the operation.

Case 6.—Mrs. B., 39 years; housewife. Two years before, an attack of left-sided sciatica lasting six weeks; she was nursing her mother, a heavy old woman, at the time. Eight weeks before admission there was a sudden recurrence of left sciatic pain, very severe, and a week later incontinence of urine occurred, but disappeared after two weeks. The severe pain passed off quite abruptly five weeks before admission, to be replaced by a feeling of numbness involving the whole of the left leg below the knee, which persisted until admission. Extensive dulling of sensation to pinprick, light touch, and heat and cold, involving L.5, S.1, S.2, and S.3 dermatomes, was present, with paresis of the extensor muscles of the left foot and great toe; the left ankle-jerk was absent. Radiographs showed a narrowing of L.5/S.1 space, and myelography a complete block at L.5/S.1 level.

AT OPERATION (1946).—Keyhole exposure, L.5/S.1. left side, enlarged by removal of part of L.5 and S.1 laminæ, There was a medially situated protrusion, with a quantity of fibrocartilage lying free between theca and medial side of S.1 root. The material included a flat, disk-like fragment, suggesting that part of a cartilaginous end-plate of the disk had been extruded. The space between the vertebræ was extremely narrow.

Here the picture was one of extensive cauda equina pressure; but there were features which made a disk hernia more likely than a neoplasm, hence our operative exposure for a disk lesion. Complete disappearance of pain and its replacement by numbness is uncommon in neoplasms; numbness may occur and spread, but pain is likely to persist. Again, the complete clearing of the urinary incontinence after two weeks suggested strongly that pressure on the cauda equina roots had lessened. The history, too—the previous bout of sciatica and its sudden recurrence two years later—was of great importance.

Case 7.—Thos. McA., 36 years; miner. Right-sided sciatic pain of six months' duration.

AT OPERATION (June, 1945).—There was a moderate-sized protrusion of L.4/L.5 disk with adherent root, and a good-sized piece of degenerate fibrocartilage was picked out after incision of the annulus. L.5/S.1 disk was explored with negative findings.

He was re-admitted in March, 1947, with the story that his sciatic pain had returned about nine months before, following a spell of work involving heavy weight-lifting. There was a Lasègue's sign of 45° on the left side, with hypo-algesia of L.5 and S.1 dermatomes and absence of ankle-jerk. Radiographs showed a narrowing of L.4/L.5 and L.5/S.1 spaces with marked osteo-arthritic lipping of the bodies of L.3, L.4, and L.5. With myelography the column of contrast medium was almost completely blocked at L.4/L.5 level.

At the second operation (March, 1947), L.4/L.5 disk was re-explored. The root was adherent, but the annulus was opened and a quantity of disk material removed. A hemilaminectomy of L.5 and the upper part of S.1 was then performed and later was extended to a bilateral laminectomy of L.5. Inside the theca could be felt a very hard mass, about 1·5 cm. in length. When the dura was split in the midline a mass was seen to the right of the cauda equina roots, which were sharply compressed. It lay within the theca and was reddish in colour, irregular in shape, and extremely hard and fibrous, with calcified portions. It was removed in three large pieces, after which the opening in the anterior wall of the theca was displayed and one could see down into the disk space, the plates of cartilage of the two adjacent vertebral bodies being clearly visible.

Rupture through the dura must be a rare occurrence. The disk-contents must stretch and rupture three firm fibrous layers, the annulus, the posterior common ligament, and the dura. There was surprisingly little functional disturbance when we consider the size of the intradural mass—there was no cauda equina tumour syndrome. Is it possible that such an intradural protrusion may accommodate itself as it lies among the cauda equina roots, so that it produces less pressure than an extradural mass of similar size?

Case 8.—Robert C., 33 years; bus driver. The story was of recurrent backache and sciatic pain of five years' duration; both legs had been affected—an alternating sciatica. Sometimes during an attack the pain had changed quite abruptly from one side to the other, but it had always been more severe and prolonged in the left leg. However, there had been long spells of freedom from pain. The patient's work also involved cranking heavy lorries and lifting sacks, and five days before admission he was stretching up, with his hand above his head, to wash the window of a bus when he felt a sudden very severe pain in the back of his left thigh and a feeling of pins and needles in the left leg and outer border of the left foot. The limb was so painful and weak that he was unable to walk to his home a few yards away. Next day he could not empty his bladder and this retention persisted, though two days later he could walk downstairs and proceed to a nearby hospital. On admission he was still in very severe pain, with retention of urine and fæces. There was analgesia of S.4 dermatome, right side, and of S.3 and S.4, left, with gross loss of power and tone in many of the muscles of the left leg, including the glutei; it was greatest in the posterior tibial group and least in the muscles of the thigh. Both ankle-jerks were absent; there was bilateral Lasègue's sign, while the movements of the lumbar spine were severely limited. Myelography revealed a complete spinal block at L.4/L.5 level.

At Operation (1945).—Bilateral laminectomy, L.5 and the greater part of L.4. A firm mass could be felt through the dura and when this membrane was opened a large fragment of fibrocartilage was seen; it seemed to fill the greater part of the lumen of the theca, the cauda equina roots being squeezed out of sight to either side. It was by far the largest protrusion encountered up till then. The mass was pulled out easily after the opening in the anterior dura had been enlarged by splitting the membrane just above the rupture. Another good-sized fragment was found lying extradurally, and just caudal to it was a third. There were thus three separate fragments, all of some size, but the intradural one was the largest by far. It is worth noting that the retention of urine cleared rapidly after operation. Urine was passed on the tenth day and by the fourteenth day residual urine was nil.

In this case, unlike the last, there were signs of very widespread pressure on the cauda equina roots, but the sudden onset and the history of attacks of alternating sciatica made tumour unlikely and little doubt was felt that we had to deal with a disk lesion. There was excellent recovery of function, showing how much pressure the cauda equina roots can stand if it is of short duration. It is interesting to speculate what became of such cases in the days before disk lesions were recognized as a cause of sciatica. What was the diagnosis; what treatment was carried out? Only very seldom must the neurosurgeon have been asked to see them.

DISCUSSION

It is odd how seldom reference is made in the literature to cases with free fragments and again how varying is the incidence in the reported series. In only two papers (Peyton and Simmons, 1947, and Kristoff and Odom, 1947) have we found the proportion of cases with free fragments to be comparable with our own. To some extent this may be explained by the criteria employed in the selection of cases for operation; the more thorough the trial of conservative treatment, the greater should be the proportion of cases like those under discussion, in which cure by anything short of operation is unlikely. In our series of 91 operations all our patients had had treatment by rest in bed or by fixation in plaster—and quite frequently by both. Again, there was a high proportion of relapsing cases. It may be suggested that a series of disk operations in which a good proportion of free fragments is found is evidence of a careful selection of patients for operation.

Differential Diagnosis.—These lesions must be distinguished from the more common types of disk hernia and from tumours of the cauda equina. From the former distinction may often be impossible (e.g., *Case* 1). The majority of our 8 cases showed, however, features which, though not distinctive, might suggest that a condition other than the usual Group-2 form of disk lesion was present. The commonest was a tendency to relapse (6 cases); the clinical picture tended to vary in the different relapses and in one case (*Case* 8) there was alternating sciatica. It is possible that the changing features may be ascribed to alteration in the position of the free fragments; an excellent example of this is *Case* 4. Naturally, the closer the resemblance to the picture of a cauda equina tumour, the more distinct were the clinical features from those of the ordinary disk lesion. Involvement of several roots (4 cases) and of bladder function (2 cases) were such features. Dandy (1942) pointed out that the picture in these cases may resemble that of secondary carcinoma of the spine with abrupt onset of symptoms, but

analysis of our case histories does not confirm this; in all there were features—e.g., relapses, partial or complete remissions—which made the story unlike that of tumour, with its steady progression of signs and symptoms.

Treatment.—It is difficult to imagine an alternative to operation in such disk lesions. Dandy (1942), however, suggested that spontaneous cure might occur in cases in which intradural rupture had taken place, but he gave no evidence to support this view. It seems reasonable to suppose, however, that a fragment free inside the theca should cause less pressure on nerve-roots than one of the same size in the extradural space. The effects of pressure on the cauda equina must vary with the proximity of the fragment to the fixed portions of the roots; the more laterally situated it is, the less the possibility of the root slipping aside and evading pressure. Inside the theca at the lower lumbar level the roots should be easily displaced and the fragment will tend to take up a position with its long axis parallel to that of the canal.

In deciding on the form of operative exposure, the clinical picture is naturally the chief guide. In cases with a cauda equina tumour type of syndrome we may start at once with a bilateral laminectomy. In a number of our cases, however, we have begun with a 'keyhole' exposure and have widened the field in steps, according to the needs of the case, and in practice this has done very well. The recognition at operation of a large fragment of disk should seldom be difficult, but there is a real danger that a small piece of fibrocartilage may be overlooked, and it is quite likely that this may explain some of the cases of persistence of symptoms after operation. Two different pictures may be seen. In one, exploration may reveal a hole in the annulus. The fragment must then be searched for until found, and this will usually involve a hemilaminectomy of the vertebra below the disk involved. The other picture is one of a nerve-root adherent to an annulus; no protrusion is seen, the aperture has been sealed by the root. There are then two possibilities: either we have a 'burnt-out' disk, or, and this is the most deceptive picture of all, there is a free fragment lying some distance from its point of exit. *Case* 4 is an excellent example; we trust we should have done a hemilaminectomy even if we had not been fortunate in getting a glimpse of a piece of fibrocartilage at the very edge of the field, and certainly the signs of an extensive lesion involving several cauda equina roots should have put us on our guard. It is easy to imagine a case of this sort where the picture is one of ordinary chronic sciatica of disk origin. The fragment may not then be searched for, and may be missed. This is an argument in favour of the routine performance of a hemilaminectomy, nearly always of L.5 vertebra, as is practised by some surgeons, and there is nothing to suggest that this causes more disturbance of function than a keyhole exposure. But if the possibility of the presence of a free fragment is borne in mind we feel the ligamentum flavum may be excised first and the aperture enlarged if there is the least suspicion that the lesion has not been revealed in its entirety.

SUMMARY

In a series of 91 patients with lumbar disk lesions, personally operated on, eleven were found to have fragments of disk material lying between the annulus and the posterior common ligament, while in eight others, the subject of this paper, the pieces of fibrocartilage had passed through the posterior common ligament and lay free within the spinal canal. In two of these a still further displacement had occurred, the ventral dura was torn and the fragments lay within the theca. Reports of the operative findings in these eight cases are given in detail. The results of an analysis of their clinical pictures are presented and their differential diagnosis from the more common forms of disk protrusion and from cauda equina tumours is discussed. Finally, the operative treatment of such free fragments is considered and it is emphasized that the smaller fragments may easily be missed and that this may be responsible for the persistence of symptoms after operation.

We have to express our thanks to various colleagues in Killearn and Stobhill Hospitals for much help during the operations and in the radiological diagnosis; to Dr. G. Joly Dixon for his helpful criticism of this paper; and to Mr. Martin Nichols, now of Aberdeen, who performed the second operation in *Case* 7.

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THE PARA-ILIAC NERVE

By F. ROLAND WILDE

DEPARTMENT OF ANATOMY, ST. BARTHOLOMEW'S HOSPITAL MEDICAL COLLEGE, LONDON

THIS account concerns the morphology and connexions of the nerve-plexus that accompanies the common iliac and external iliac arteries in man. A suggestion that this iliac network consists simply of an offshoot from the aortic plexus appears to have been made, in the first instance, by Bichat (1802). This belief has received support in recent years from the results of experiments upon laboratory animals.

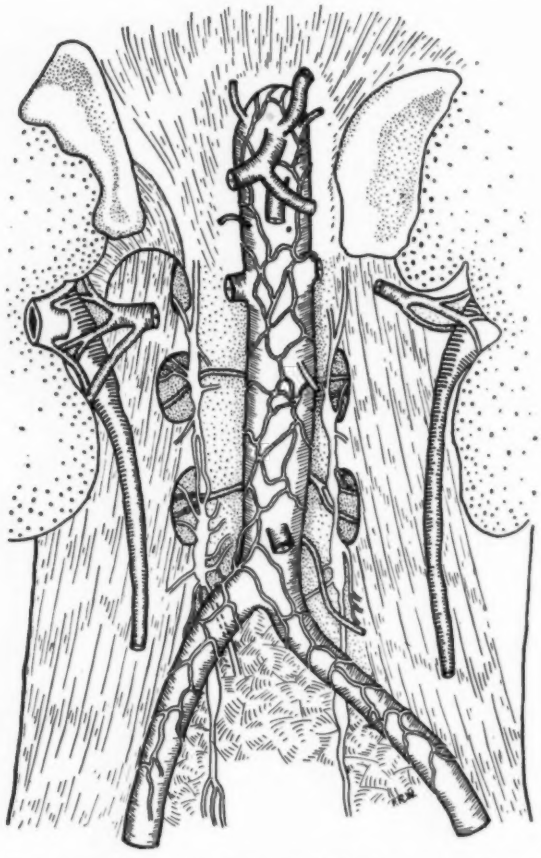

FIG. 711.—Diagram to show continuity between aortic and common iliac nerve-plexuses. (After Hovelacque.)

An examination of the region in human fœtuses has failed to establish any evidence of direct connexion between the aortic and common iliac nerve networks. The aortic plexus was observed to cross the bifurcation of the abdominal aorta and enter the true pelvis. A discrete nerve-bundle, here termed the 'para-iliac nerve', joined the common iliac artery and formed a coarse nerve-plexus thereon.

Historical.—Bichat (1802) was aware of the existence of a nerve-plexus upon the abdominal aorta. This plexus was observed to divide at the level of the pelvic brim into two parts: (*a*) a large central formation composed of interlacing nerve strands which descended into the pelvis, and (*b*) a smaller, lateral, contribution of nerve-fibres that rarely interlaced as they accompanied the common and external iliac arteries to the groin. Cruveilhier (1852) described a branch to the external iliac artery derived from the genitofemoral nerve. Sappey (1871) confirmed the observation that a 'vascular' nerve filament originated from the genitofemoral nerve. This nerve filament was very fine, and of considerable length, being traceable along the external iliac artery as far as the groin.

Krause (1879) described arterial branches from both divisions of the genitofemoral nerve. The N. spermaticus externus supplied a branch to the external iliac artery, whilst from the N. lumbo inguinalis a twig was provided for the femoral artery. Schwalbe (1881) confirmed the presence of a vascular nerve branch from the N. spermaticus externus. Thane (1897), in an account of the topography of the genitofemoral nerve, mentioned those vascular filaments previously observed by Krause.

Berglas (1925) dissected the perivascular nerve filaments upon the iliac vessels. He concluded that the aortic plexus was continued along the iliac and femoral vessels to the more distant parts of the vascular tree. However, Hirsch (1925) was unable to demonstrate the presence of a continuous nerve-plexus extending from the aorta to the iliac arteries. Using binocular magnification, Hirsch failed to discover any substantial contribution from the aortic plexus to the iliac vessels. The filaments observed were so small as to be of doubtful physiological significance.

Woollard (1926) employed a methylene blue intravitam staining technique, using laboratory animals that included the rat, guinea-pig, cat, and dog. Lumbar sympathectomies and periarterial neurectomies of the common iliac and external iliac arteries were performed. The conclusions formulated from this signal investigation are well known and may be briefly summarized as follows: The adventitial plexus on the abdominal aorta, composed almost entirely of non-myelinated nerve filaments, was observed to form a plexus on the iliac arteries which, in the dog, disappeared towards the distal part of the femoral artery. The precise point of termination of the plexus was more difficult to ascertain in the cat because an *intramural* plexus may be formed in this animal. From experimental evidence, the bifurcation of the common femoral artery was indicated as the distal extent of the aortic plexus in the cat. A second type of vessel innervation, by filaments derived from adjacent peripheral nerve-trunks, was found to supply the more distal arteries of the limb. These nerve filaments were, by contrast, predominantly myelinated, a structural feature which suggested the hypothesis that peripheral nerve branches supplying main vessels were partly sensory in function.

Hovelacque (1927) described vascular branches from the lumbar sympathetic chain. These nerve filaments formed a plexus which completely

encircled the aorta. Distally, the aortic plexus continued along the common iliac arteries and their branches (*Fig.* 711). The genital branch of the genitofemoral nerve provided a vascular nerve filament to the external iliac and the common femoral arteries.

Coates (1931) described a branch to the external iliac artery derived from the femoral nerve within the false pelvis. Delmas and Laux (1931) indicated the route for vasomotor fibres to the common iliac artery, this being via the interiliac plexus from the third and fourth lumbar sympathetic ganglia. two to three branches which ran to the superficial aspect of the vessel; and (*b*) the sympathetic chain, usually via the fifth lumbar ganglion, from which branches were directed to the deep aspect of the common iliac vessels. Lazorthes (1939) found, in 2 cases, a long filament derived from the second lumbar sympathetic ganglion which ran onto the aorta, whence branches were observed to follow the deep surface of the common iliac artery. Branches from the third lumbar ganglion passed behind the aorta, or inferior vena cava, and joined the presacral nerve before supplying filaments to the

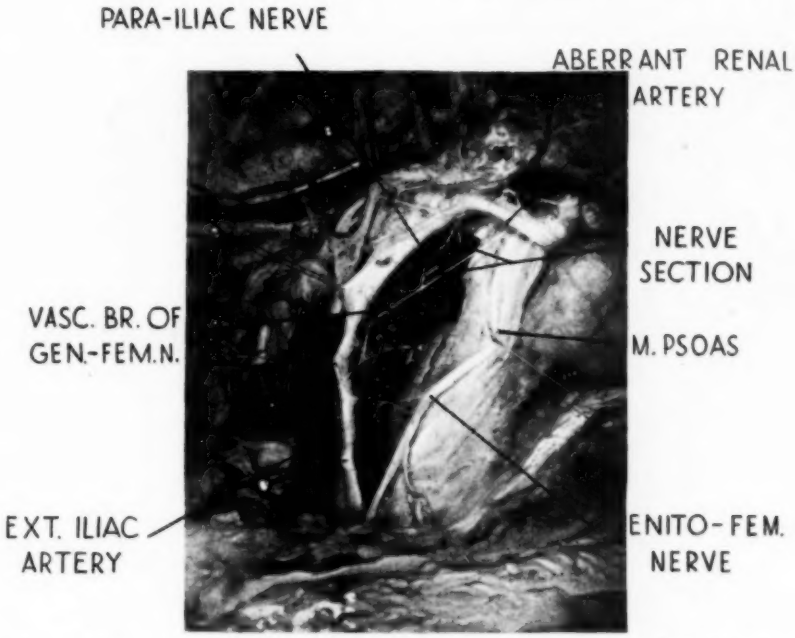

FIG. 712.—Dissection to show: (*a*) Two para-iliac nerves forming plexus on left common iliac artery; and (*b*) vascular branch of genitofemoral nerve supplying plexus on left external iliac artery.

The external iliac artery also received nerve filaments from the femoral and genitofemoral nerves. Delmas and Laux concluded that the external iliac artery constituted a zone of transition from a visceral to a parietal type of vessel innervation.

Stopford (1931) cited a case in which arterial thrombosis of the lower limb vessels had ensued following prolonged irritation of the lumbar sympathetic chain by a neurofibroma. He suggested that some of the myelinated, and hence presumably afferent, fibres in the periarterial plexus might form a part of the deep sensory pathway.

Zuckerman and Burr (1934) observed, in the rhesus monkey, a fine nerve filament running directly to the external iliac artery from the fifth lumbar sympathetic ganglion. This same filament might join the genitofemoral or obturator nerves, and was regarded as a sympathetic filament situate independently of the rami communicantes. Zuckerman and Burr emphasized that such aberrant nerve branches always originate from the fifth lumbar ganglion.

Courty (1938) described vascular nerve filaments to the common iliac vessels derived from two sources: (*a*) the pelvic splanchnic nerves, by from common iliac artery. Below the aortic bifurcation many branches were traced from the presacral nerve to the common iliac vessels. Filaments derived directly from the lumbar sympathetic chain ganglia were rarely found. The external iliac artery was innervated almost entirely by filaments from the genitofemoral nerve.

MATERIAL AND METHOD

Twenty dissections were performed upon full-term stillborn human fœtuses. The fœtal circulation was washed through with 30 per cent methylated spirit by means of a cannula inserted into the umbilical vein. The material was preserved in 30 per cent spirit after removal of the intracœlomic viscera. Specimens treated in this manner may be kept indefinitely, and show little trace of hardening as produced by so many chemical fixatives, notably formalin.

The specimens were dissected under water, using binocular magnification of from ×5 to ×10 diameters. The manipulations were performed with standard ophthalmic instruments, the surrounding tissues being retracted, as the work progressed, by stay sutures of the finest silk or 1–1500-in. stainless

steel wire (*Fig.* 712). Histological examination of the dissected nerve strands was performed subsequently to confirm their neural composition (*Fig.* 713).

Dissection was commenced by stripping the parietal peritoneum from the posterior abdominal wall and false pelvis. A modification of Mitchell's (1935) water infiltration technique proved well suited to this purpose. The intermesenteric nerves were then exposed by dissection caudad to the origin of the superior mesenteric artery. Dissection was continued distally along the course of the abdominal aorta and inferior vena cava, exposing the renal plexus, lumbar sympathetic chain, and the roots of the lumbar plexus. The ureters were divided at the level of the pelvic brim and the common and external iliac vessels examined. The dissection was completed by removal of the inguinal ligament, this enabling the study to be extended to the terminal filaments of the perivascular nerve-plexus on the external iliac vessels.

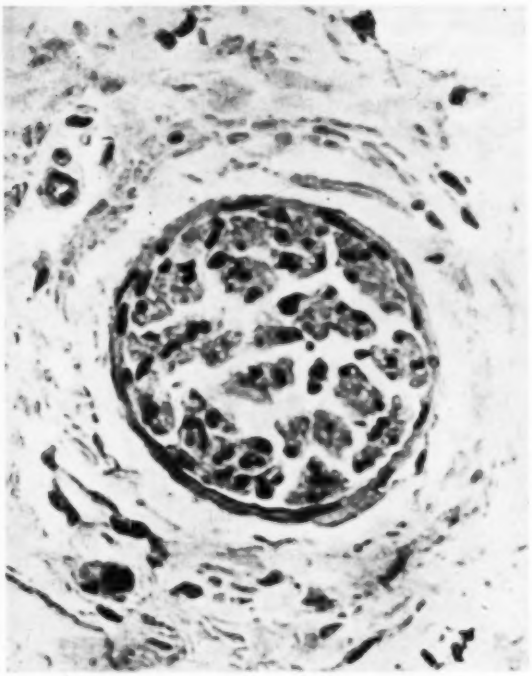

FIG. 713.—Photomicrograph showing para-iliac nerve. (× 420.)

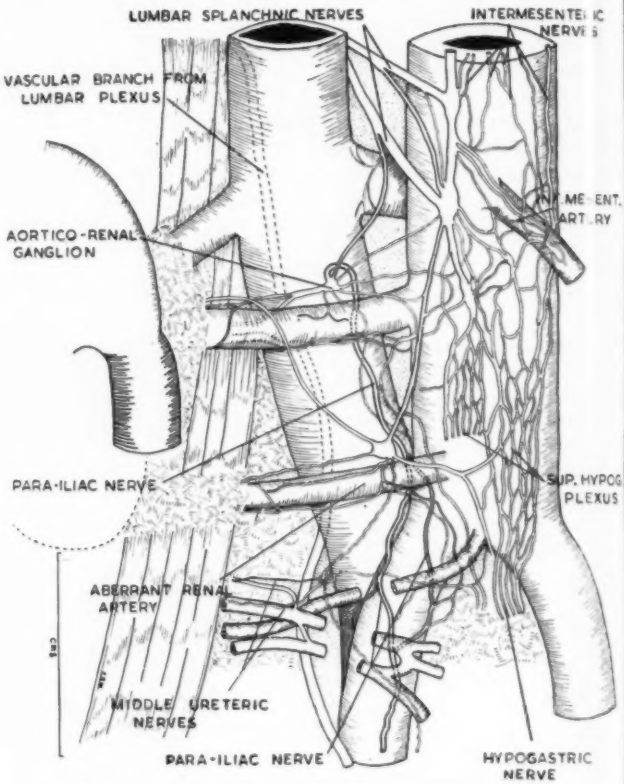

FIG. 714.—Scale drawing of dissection to show: (*a*) origin of right para-iliac nerve from aortico-renal ganglion; and (*b*) contribution from middle ureteric nerves to common iliac plexus.

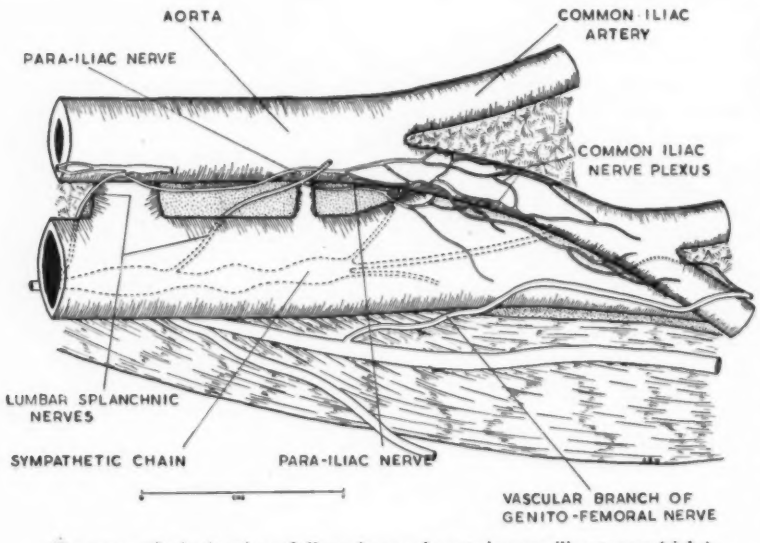

FIG. 715.—Scale drawing of dissection to show twin para-iliac nerves (right).

FINDINGS

The Aortic Plexus is formed predominantly by nerve filaments derived from the cœliac plexus. Caudad to the origin of the superior mesenteric artery the aortic plexus has the appearance of a number of discrete nerve strands. These intermesenteric nerves, 4–12 in number, intercommunicate at intervals and receive branches from the lumbar sympathetic chain ganglia via the lumbar splanchnic nerves (*Fig.* 714). Below the origin of the inferior mesenteric artery cross-connexions between the filaments of the aortic plexus become more numerous, to form the superior hypogastric plexus (presacral nerve). The superior hypogastric plexus subdivides, at the level of the pelvic brim, into two well-demarcated strands, the right and left hypogastric nerves, which cross the common iliac arteries and enter the true pelvis.

There is no evidence from the present series of dissections that any part of the superior hypogastric plexus is continued, as a periarterial network, along the common iliac vessels.

The Para-iliac Nerve was present on both sides of each specimen. The *origin* of this robust nerve-bundle derived from the second or third lumbar splanchnic nerve (*Fig.* 715), in 10 cases, and from the intermesenteric nerves at the level of the origin of the inferior mesenteric artery (*Fig.* 716), in a further 6 cases. Two specimens showed the para-iliac nerve originating from the aortico-renal ganglion (*Fig.* 717); it will be observed that the main renal artery takes an unusually low origin from the aorta. The para-iliac nerve was paired on each side in 2 cases (*Fig.* 716), the larger branch arising from the intermesenteric nerves, and the lesser filament originating from a ganglion in relation to an aberrant renal artery. *Fig.* 715 shows the condition in a specimen where para-iliac nerves of approximately equal size were found to arise from the second and third lumbar splanchnic nerves.

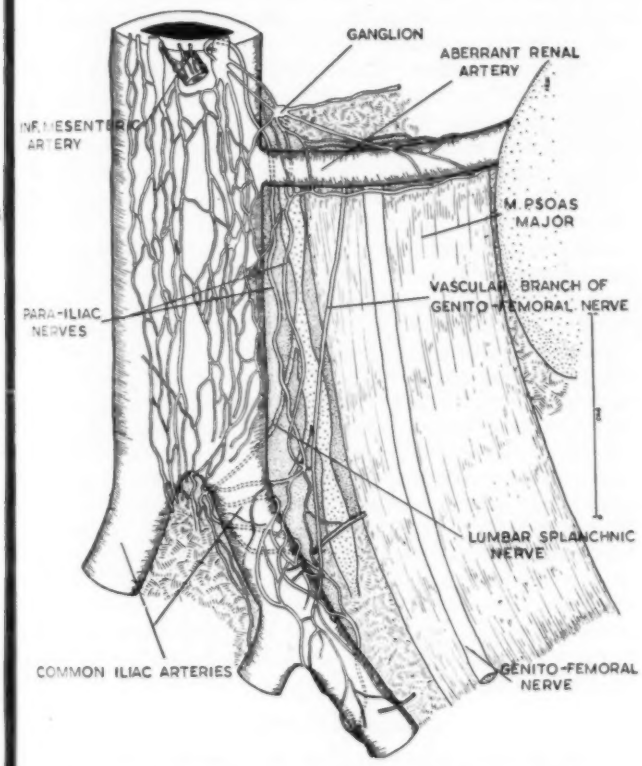

FIG. 716.—Scale drawing to show origin, course, and distribution of twin para-iliac nerves (left).

The *course* of the para-iliac nerves shows certain differences on the two sides. The right nerve lies deeply in the sulcus between the abdominal aorta and the inferior vena cava. Following the course of these main vessels the right para-iliac nerve divides into from two to three branches at a point situate 0·5–1·0 cm. proximal to the level of the aortic bifurcation. The branches again subdivide into fine nerve filaments that comprise the perivascular plexus upon the common iliac vessels. The para-iliac nerve crosses the deep aspect of an aberrant renal artery (*Figs.* 714, 717), and, when arising from the aortico-renal ganglion, may run deep to the main renal artery itself.

The left para-iliac nerve lies on the left lateral aspect of the abdominal aorta, situate deeply in the groove between the aorta and the left M. psoas major. The para-iliac nerve is superficial to the left lumbar sympathetic chain and may cross one or more of the lumbar splanchnic nerves (*Fig.* 716). The left para-iliac nerve was found to pass deep to an aberrant renal artery (*Fig.* 716), this conforming to the similar observation on the right side.

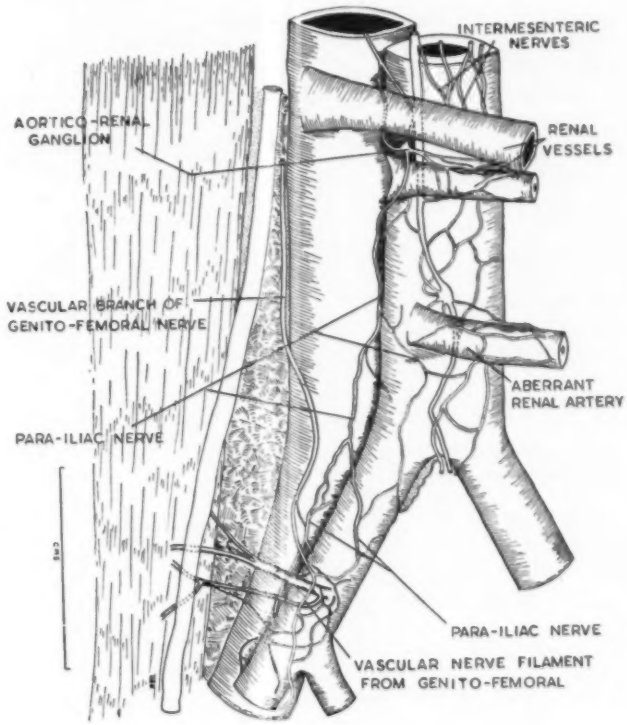

FIG. 717.—Scale drawing of dissection to show: (*a*) right para-iliac nerve arising from aortico-renal ganglion; and (*b*) vascular branch of genitofemoral nerve derived from roots of lumbar plexus. (Renal blood-vessels retracted to left.)

The *termination* of the para-iliac nerves shows a similar pattern on the two sides. The main bundle divides into two or three branches at a point 0·5–1·0 cm. proximal to the bifurcation of the aorta. These nerve branches give rise to terminal filaments which form a coarse nerve-plexus upon the adventitia of the respective common iliac artery. Distal to the bifurcation of the common iliac artery this nerve-plexus is reinforced by a large and very constant branch derived from the genito-femoral nerve (*Figs.* 715–718). It is impossible to assess, from a mere topographical study, the further ramification of fibres from the para-iliac nerve throughout the external iliac nerve-plexus.

Histological appearances of the para-iliac nerve were studied by routine methods. *Fig.* 713 is a photomicrograph of the para-iliac nerve, showing typical appearances of a non-myelinated nerve-bundle.

The Common Iliac Nerve-plexus.—

Topographical Appearances.—The common iliac vessels are surrounded by a connective tissue sheath

containing within its substance numerous lymphatic vessels. Such lymphatic channels may be distinguished from nerve filaments by their larger calibre, straight course, and, as occurs not infrequently under the dissecting microscope, by their appearance as hollow tubes.

Once these overlying structures have been removed, and fixation governs the magnitude of this tedium, the coarse perivascular nerve-plexus may readily be identified. The plexus encircles the common iliac artery, giving delicate filaments to the companion vein. No evidence was obtained of an

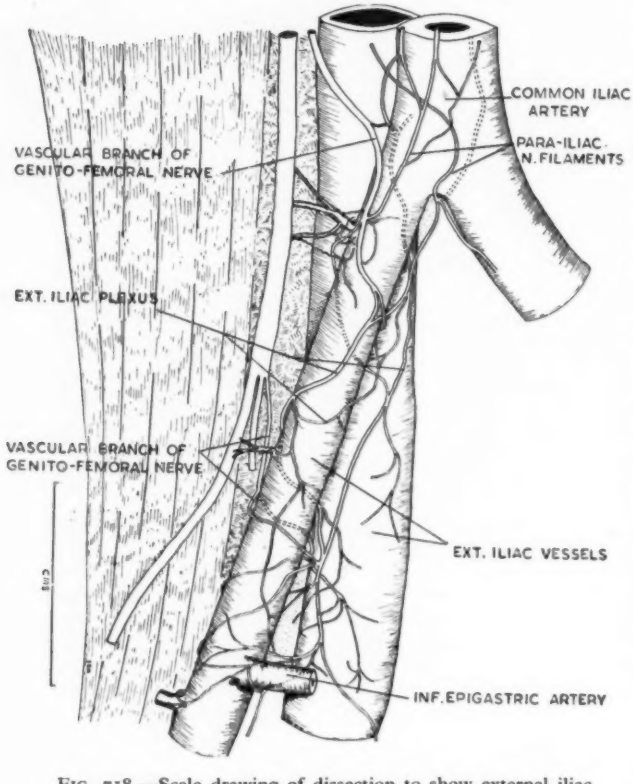

FIG. 718.—Scale drawing of dissection to show external iliac nerve-plexus (right).

encircling nerve-plexus in relation to the common iliac vein, the offshoots from the arterial plexus appeared rather to form sprays of terminal nerve filaments upon the adventitia of the vein.

Connexions.—The common iliac nerve-plexus is formed, almost exclusively, by fibres from the para-iliac nerve. Proximally, a connexion may sometimes be established through very fine nerve filaments, with the pre-aortic nerve-bundles situated deep to the superior hypogastric plexus (*Fig.* 714). Centrally, connexions are frequently established between the common iliac plexus and the middle ureteral, or the inferior spermatic nerves (*Fig.* 714). Distally, the plexus merges into the external iliac nerve-plexus where a communication is constantly formed between the para-iliac and genitofemoral nerve branches.

The External Iliac Nerve-plexus.—

Topographical appearances are those of a coarse nerve-plexus lying in contact with the adventitia of the external iliac artery. The nerve-bundles are large, and numerous by comparison with those comprising the common iliac plexus. Collateral filaments from the arterial plexus form terminal arborizations upon the external iliac vein.

The *connexions* of the external iliac plexus are; proximally, with the common iliac plexus by direct continuity, and with the main vascular branch of the genitofemoral nerve. Centrally, one or more additional twigs may join the plexus from the genitofemoral nerve (*Fig.* 718). Distally, the external iliac plexus provides nerve loops and fine arborizations about the origin of the inferior epigastric artery. Beyond this point the plexus is reduced to one or two fine strands which accompany the artery beneath the inguinal ligament.

The Vascular Branch of the Genitofemoral Nerve.—This constant branch, the doyen of vascular nerve filaments, arises from the medial division of the genitofemoral nerve (N. spermaticus externus) (*Figs.* 712, 715–718). The vascular branch inclines medially, forming an acute angle with the parent nerve, and crosses the medial border of M. psoas major to join the external iliac plexus. Frequently, the vascular branch from the genitofemoral nerve arises directly from the roots of the lumbar plexus and emerges, on the right side, from the deep trough between the inferior vena cava and the medial border of M. psoas major (*Fig.* 714). The nerve inclines medially at the level of the bifurcation of the aorta to lie on the superficial surface of the right common iliac vein. Reaching the origin of the external iliac artery, the nerve inosculates thereon with filaments from the para-iliac nerve to form the external iliac plexus. From a similar high origin on the left side, the nerve follows the medial border of the M. psoas major, lying superficial to the lumbar sympathetic chain, and lateral to the left para-iliac nerve. The branch terminates, as on the right side, by forming the external iliac plexus in conjunction with the left para-iliac nerve.

DISCUSSION

Bichat (1802) described the aortic plexus and noted its division, at the pelvic brim, into a central moiety and two lateral 'slips'. The latter components of the aortic plexus accompanied the iliac vessels, forming a nerve-plexus thereon. This anatomical concept has prevailed to modern times, as witness the illustration after Hovelacque (1927) (*Fig.* 711). Hirsch (1925) alone has challenged the statement that numerous branches, derived from the presacral nerve, form a plexus on the common iliac artery.

Woollard (1926) laid the foundation of a new, experimental, approach to this matter. His conclusions have remained the corner stone of scientific thought and surgical practice in the complex problems of main vessel innervation. Woollard proved, by degeneration experiments, that a perivascular nerve-plexus was built up along main limb vessels by a process of multiple recruitment from local peripheral nerves. The hypothesis that a limited perivascular neurectomy could produce widespread effects was thus completely discredited.

Woollard conceded, however, that for a limited distance, at the proximal end of the limb, the main vessels derived their innervation directly from the

aortic plexus. In the dog, filaments from the aortic plexus extended to the distal part of the femoral artery, but the precise situation varied in different species of laboratory animal. It is perhaps unfortunate that these results have sometimes been applied to man, not only in principle, but also in the details of morphology.

The present series of dissections supports Woollard's conclusions, for in its proximal extent the peri-arterial nerve-plexus of the lower limb vessels is formed by direct branches from the autonomic nervous system. In man, such branches have the morphological appearance of one or more discrete nerve-trunks, here termed the para-iliac nerves, that arise from the lumbar splanchnic or intermesenteric nerves. It is noteworthy that in 50 per cent of these twenty dissections the operation of lumbar sympathectomy might be expected to produce degeneration in the common iliac nerve-plexus, as observed by Woollard in his experimental animals. The dissections indicate that to achieve a successful denervation of the common iliac artery in all cases would require the further procedure of high pre-aortic neurectomy, above the level of the inferior mesenteric artery.

The external iliac artery is indicated as the most probable site of transition from a direct to an indirect type of autonomic innervation of the main lower limb vessels. The contribution from the genitofemoral nerve is a large and constant branch which reaches the axial vessels precisely at the commencement of the external iliac artery. But it is not permissible to formulate any definite conclusion from a mere topographical study. It may be that filaments from the para-iliac nerves penetrate the external iliac plexus for some distance. Nor may one disregard the observation by Woollard of an intramural plexus, which, if present in man, would vitiate conclusions based on the findings of macroscopical dissection.

SUMMARY

1. The formation and connexions of the nerve-plexus situate perivascular to the common iliac and external iliac vessels was studied by dissection in the human fœtus.

2. Twenty specimens were examined under the dissecting microscope following fixation and preservation of the material in 30 per cent methylated spirit.

3. A coarse nerve-plexus was observed to encircle the common iliac artery and provide collateral filaments to the companion vein.

4. The common iliac nerve-plexus was derived in every case from a discrete nerve filament, here termed the para-iliac nerve.

5. The para-iliac nerve is a bilateral structure, and took origin from the following sources: (*a*) the 2nd or 3rd lumbar splanchnic nerve (10 cases, 50 per cent); (*b*) the intermesenteric nerves (6 cases, 30 per cent); (*c*) the aortico-renal ganglion, and (*d*) the ganglion in relation to an aberrant renal artery. The para-iliac nerve was represented by two nerve filaments on each side in 2 specimens, 10 per cent.

6. A plexus was formed upon the external iliac artery by the 'vascular' branch of the genitofemoral nerve, together with terminal filaments from the para-iliac nerve.

7. The findings herein outlined conform to the principles enunciated by Woollard (1926), but differ in certain details from the topographical appearances in laboratory animals.

8. The operation of lumbar sympathectomy may be anticipated to denervate the common iliac vessels in 50 per cent of cases. It is apparent, from this anatomical study, that a high pre-aortic neurectomy, above the level of the inferior mesenteric artery, would be required to ensure denervation of the remainder.

My thanks are due to Professor G. A. G. Mitchell, of the Department of Anatomy in the University of Manchester, for his ready help and guidance in the technique of fine nerve dissection and for the privilege of examining his exquisite prosections. Also to Professor A. J. E. Cave, in whose department the work was completed.

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PSEUDOTUBERCULOID REACTION FOLLOWING IRRADIATION OF THE SKIN

By B. B. MILSTEIN

JOHN MARSHALL FELLOW IN SURGICAL PATHOLOGY
FROM THE DEPARTMENT OF MORBID ANATOMY AND THE SURGICAL UNIT, UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, LONDON

THE histology of the late changes following irradiation of the skin has been known for many years. An unusual reaction with the formation of pseudotubercles has been described recently by Larsson (1949), who reviews 26 cases. The pseudotubercles, which were found in the subcutaneous tissue and muscle, were composed of epithelioid cells and giant cells, surrounded by a ring of lymphocytes and an outer layer of fibrous tissue. An area of necrosis in the centre was sometimes found. As no similar condition has been recorded in the British literature, a recent case in which this reaction was found and which seems to demonstrate the aetiology prompts this report.

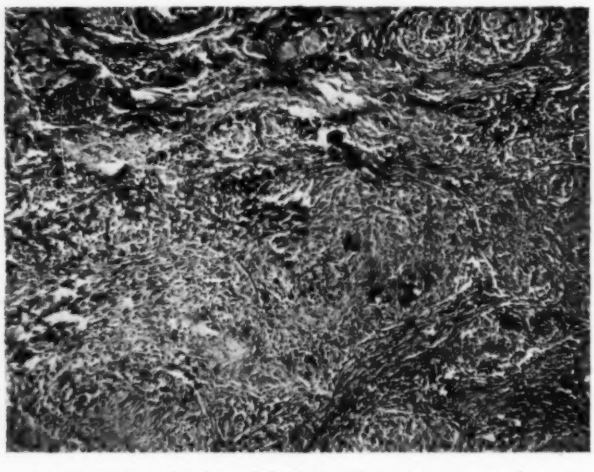

FIG. 719.—Pseudotuberculoid lesions in subcutaneous tissue. (× 52·5.)

CASE REPORT

The patient, a man aged 59, had had a basal-cell carcinoma near the left nasal fold four years previously which had been treated by the insertion of seven radium needles. The ulcer healed, but six months before admission the patient noticed lumps developing at the sites of insertion of the needles. They were painless and were not getting larger. The nodules were hard and raised, and situated at the scars of the needle punctures. The skin at the site of the previous rodent ulcer was white, atrophic, and telangiectatic, but there was no evidence of recurrence. The nodules were treated by wide excision and plastic repair of the defect in the skin. Two years later the graft was healthy and there was no sign of recurrence.

Examination of sections of the tissue removed, stained with hæmatoxylin-eosin, Van Gieson, Mallory, Weigert's elastic stain, and silver diaminocarbonate, showed changes in the skin, subcutaneous tissue, and muscle. Apart from the usual irradiation changes in the glands, vessels, and connective tissue, many pseudotubercles were present in the subcutaneous tissue and muscle (*Fig.* 719). They consisted of agglomerations of pale eosinophil epithelioid cells 13–17 μ in diameter, surrounded by lymphocytes, with a few scattered giant cells, some of Langhans type and some of foreign-body type. A few of these giant cells were found within the tubercles, but many of them lay isolated in the surrounding connective tissue. The centres of the larger tubercles had undergone necrosis, leaving structureless areas, staining reddish-pink with eosin. These were surrounded by a zone of unstained material with a fibrillary structure which represents hyalinized fibrous tisssue (*Fig.* 720). Many of the pseudotubercles were surrounded by fibrous tissue.

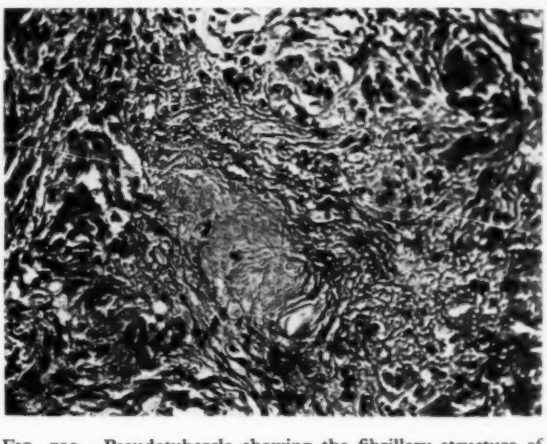

FIG. 720.—Pseudotubercle showing the fibrillary structure of the central area of 'necrosis'. (× 166.)

Smaller isolated tubercles were found in the muscle, but these did not show any necrosis (*Fig.* 721). When these sections were originally examined, they were reported to show the changes of sarcoidosis, with necrosis. In view of Larsson's report they were re-examined, since it appeared that the pathological findings in this case were identical with those described by him.

Numerous Ziehl-Neelsen stained sections were examined for tubercle bacilli, but none were found. The sections were also examined by polarized light for the presence of doubly refractile material. Some scattered refractile particles were found, some within the tubercles and some of them in the subcutaneous tissue without a reaction round them. A few were found within giant cells (*Fig.* 722). The larger ones were round, the smaller rod-shaped, straight, or slightly curved.

DISCUSSION

The nature of this reaction was not elucidated by Larsson, who has discussed the possibilities in detail. The absence of tubercle bacilli does not exclude tuberculosis as a cause, but this patient had no other signs of tuberculosis and the histological picture is not typical of that disease. A foreign-body reaction is likely, and might be due to the introduction of talc on the radium needles. The amount of talc introduced would naturally be much smaller

than in an open operation, but a reaction can be produced by a small quantity of talc. The classical talc granuloma contains masses of doubly refractile material, but talc granulomata in scars may only show a few talc crystals. Talc granulomata in scars have been described many times (Lichtmann, McDonald, Dixon, and Mann, 1946).

Saxen and Tuovinen (1947) have shown experimentally that small quantities of talc in the tissues may not cause granulomata, but that when the tissues have been traumatized the same quantity may produce a reaction. They found that the histological appearance of the lesions in his cases he stated that the giant cells often contained inclusions which were usually rod-like, rather strongly refractive, particles, unstained by Van Gieson. He thought that these were probably derived from disintegrating tissue, although he considered that they might be foreign bodies. He mentioned the possibility of talc granuloma, but stated that no foreign bodies resembling talcum particles were found in the sections. It seems likely that if the polarizing microscope had been used, talc crystals would have been recognized.

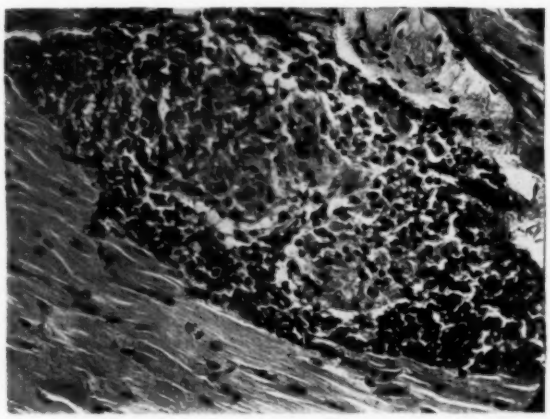

FIG. 721.—Pseudotubercle in muscle, showing many epithelioid cells and ring of lymphocytes. (× 166.)

FIG. 722.—Giant cells from lesion in *Fig.* 720, showing doubly refractile talc particles in the cells. Polarized light, half-extinction. (× 166.)

reaction was much more intense in the presence of necrosis. The extreme variability of the reaction to talc has been commented on by Lichtmann and others (1946), who thought that trauma or infection provided the added injury that caused nodule formation to occur. They state that granulomata have been reported in scars from two months to thirty-six years after the introduction of talc. It is interesting, therefore, that Larsson (1949) noted that the pseudotuberculoid changes occurred from three to twenty-four years after irradiation in his series.

Lichtmann and others (1946) also found in experimental talc granulomata that after ninety-six days some nodules showed "a limited amount of fibrillar tissue with little apparent arrangement", a description which would fit the findings in the present case. Similarly McCormick and Ramsey (1941), in a study of talc granulomata, stated that "pathologically, some of the lesions resemble tubercles and may show central caseation and necrosis".

All Larsson's cases, except one, followed the implantation of radium needles. In describing the

If the deductions from this isolated case are applicable generally, it would seem that the pseudotuberculoid reaction following interstitial irradiation is due to a talc granuloma which results from the introduction of small quantities of talc on the needles, and that its production is facilitated by the trauma and necrosis of the tissues following irradiation.

My thanks are due to Professor G. R. Cameron for suggesting this report and for much helpful advice; and to Mr. A. Bligh for the photomicrographs.

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IMPACTED POSTERIOR FRACTURE-DISLOCATION OF THE TEMPOROMANDIBULAR JOINT*

By BURNS PLEWES and A. K. MIGHTON, Toronto, Canada
FROM THE DEPARTMENT OF SURGERY, TORONTO EAST GENERAL AND ORTHOPÆDIC HOSPITAL

Posterior dislocation of the mandibular condyle is very rare. According to Klemens (1931) it was first recorded in the fourteenth century by Guy de Chauliac, a French surgeon of Avignon. Case reports have appeared since that time in the French, German, and Italian literature; in many of these the condyle was displaced to lie beneath the external auditory canal; in others there was a shattering of the tympanic plate, but no impaction. An Italian, Biagi, described an impacted posterior fracture dislocation in 1934 and his review is complete and authoritative. No such case has been found recorded in the British or American literature, although according to Wakeley some have occurred and have not been reported. King (1854) had a very similar case, but he concluded that there was an accompanying separation of the symphysis.

A B

Fig. 723.—Photographs shortly after admission, showing deviation of the mandible and bleeding from the ear.

CASE REPORT

A. W., a 69-year-old workman, was brought to hospital on Nov. 14, 1949, following an automobile accident. He complained of deafness and pain in the region of the right ear, and expressed the fear that he might have swallowed his lower denture. He had been riding in the rear seat and his chin had struck the back of the front seat. He found his upper denture on the floor of the car; his lower denture was found later undamaged.

The patient was unable to open his mouth, and the lower jaw was deviated to the right and immobile (*Fig.* 723 A). Any attempt at active or passive movement increased the pain in the region of the right ear. There was a transverse laceration on the point of the chin, 1¼ in. in length. Blood flowed from the right external auditory meatus (*Fig.* 723 B). The canal contained gross blood and fragments of cartilage, and hearing was markedly impaired on that side.

A year previously he had been in an automobile accident, suffering avulsion of the scalp and a depressed fracture of the left malar bone. Recovery had been complete and satisfactory. Functional inquiry and the history of any past illness did not contribute any relevant facts to the present condition.

The initial X-ray films were unsatisfactory. The true nature of the lesion was not at first recognized, and attempted reduction under general anæsthesia was unsuccessful. Further X-ray films were taken (*Fig.* 724) and showed the condyle of the mandible to be situated

* Read before the Section of Surgery, Academy of Medicine, Toronto, March 21, 1950.

FIG. 724.—Radiograph, showing condyle in auditory canal.

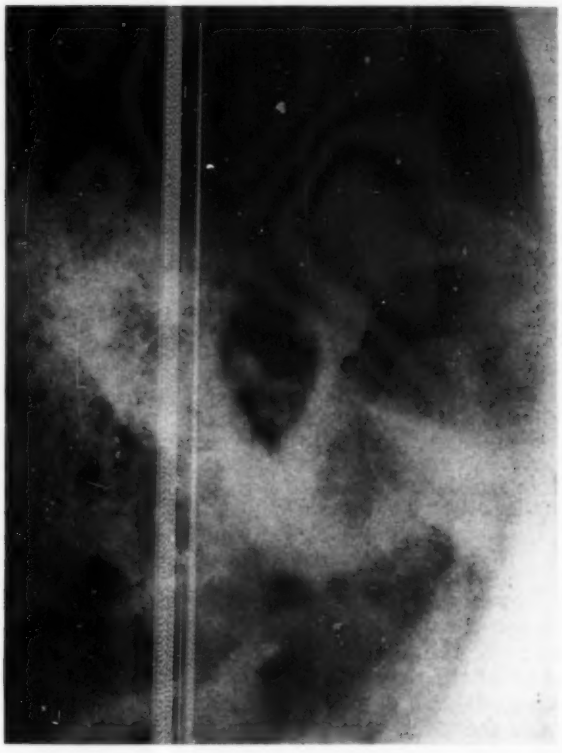

FIG. 725.—Radiograph, after reduction, showing condyle in normal position in its fossa.

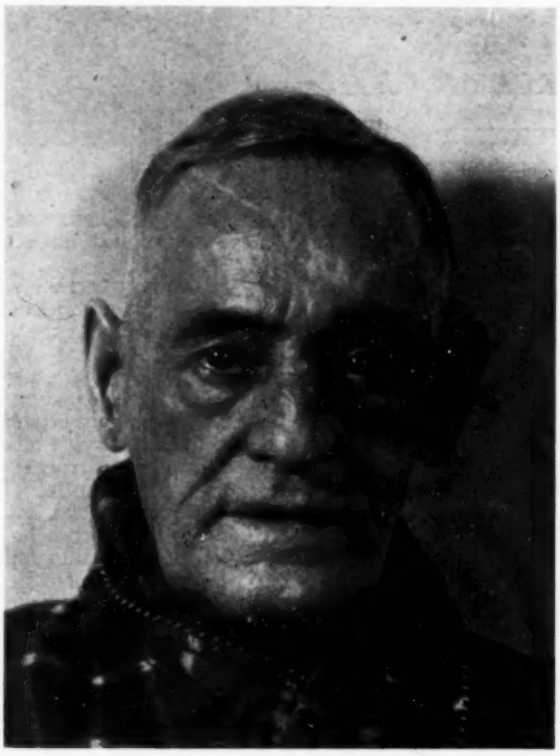

FIG. 726.—Photographs after reduction, showing deformity corrected.

in the external auditory canal. There was no fracture of the mandible.

After admission to hospital and administration of penicillin, reduction was accomplished under general anæsthesia on Nov. 16. The meatus was cleared of blood and fragments of cartilage and bone. The mandibular condyle could then be seen within the auditory canal, filling its lumen. Reduction was affected, suddenly, by pulling forward on the right side of the jaw with the head held fixed, and at the same time using a blunt periosteum elevator as a lever between the condyle and the posterior wall of the canal.

Following the operation the deformity of the jaw disappeared and the pain about the right ear was relieved. Wearing his dentures, the patient could use his jaw for mastication (*Fig.* 726). Post-reduction X-ray films (*Fig.* 725) showed the mandibular condyle in normal position in its fossa. Penicillin and sulphadiazine powder were insufflated into the aural canal, and penicillin was administered parenterally. Healing of the auditory canal proceeded satisfactorily; hearing was restored to normal. A rubber dilator was used to prevent stenosis. There remained an area of scarring visible on the antero-superior aspect of the canal.

DISCUSSION

Posterior dislocation of the mandible is rare because of several anatomical features, and can only occur in the elderly. In the younger adult the ramus of the mandible forms a right-angle with the body and this is emphasized by the alveolar processes. But in the elderly the angle of the mandible becomes more and more obtuse, and with the loss of the teeth and absorption of the alveolar processes the bone becomes nearly straight. The buttress formed by the postglenoid process of the squamous temporal bone varies a great deal in different skulls, but when well developed forms a strong buffer against posterior displacement of the condyle of the mandible. The size of the temporomandibular ligament running downward and backward, the pad of fat, and prolongation of the parotid gland filling the space between the condyle and the tympanic plate varies, and all would militate against posterior dislocation. It would seem, therefore, that only in the edentulous jaw of an older subject and in the absence of artificial dentures can strong force sustained on the point of the chin be directed immediately through the shaft of the straightened bone, resulting in a backward dislocation and driving the condyle, as it must, towards the auditory canal. This prerequisite concatenation of anatomical change and circumstance seems to explain why this lesion is so unusual.

It is a pleasure to express our thanks to Dr. A. R. McGee, radiologist; Dr. Hawthorne Steele, oto-laryngologist; to the photographic department of the Toronto East General Hospital; to Miss E. M. Poole, Librarian of the Toronto Academy of Medicine; and the Army Medical Library, Washington, D.C.

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A CASE OF RHABDOMYOSARCOMA OF THE THIGH

By PHILIP SOMERVILLE
SENIOR SURGICAL REGISTRAR, KING'S COLLEGE HOSPITAL, LONDON

THE occurrence of tumour formation in muscle has for long been regarded as infrequent, and its characteristics are for this reason not widely known. A useful review of rhabdomyosarcoma was given by Stout (1946) in a series of 121 cases, 14 from personal records and the rest extracted from the literature, including those amongst a series of soft-tissue tumours reported from Radiumhemmet by Jönsson (1938). The interest in this case lies in the occurrence of an uncommon tumour of very rapid and persistent growth in a patient of advanced years. This is the third case of rhabdomyosarcoma to be admitted to King's College Hospital over the past 4 years. The previous 2 cases were reported by Childs in The BRITISH JOURNAL OF SURGERY (1949).

CASE REPORT

A woman, aged 84 years, was admitted on Jan. 26, 1950, complaining of a swelling in the right thigh and pain in the right leg, both of which had been present for three months. She also complained of a lump in the left breast which she first noticed six months previously. The swelling of the thigh had slowly increased in size since its onset and the pain had been slowly increasing in intensity, being localized at first but more recently spreading up and down the leg. There was no history of trauma of any consequence and no other symptoms.

ON EXAMINATION.—The patient was fit for her age, with no abnormality in her heart, lungs, or abdomen. The right thigh showed a smooth swelling about the size of a coco-nut, with its long axis parallel to that of the thigh and situated on the outer side (*Fig.* 727). It was soft in consistency but became harder on contraction of the muscles and was not fluctuant. It was not attached to skin and appeared to lie deep in the lateral part of the quadriceps muscles. There was mild tenderness on palpation and slight increase in skin temperature. No inguinal glands were palpable. The lump in the breast was an obvious scirrhous carcinoma with attachment to skin and two palpable glands in the axilla. Radiographs of the chest and right femur showed no abnormality. A differential diagnosis of hæmatoma due to mild trauma, chronic abscess, or rhabdomyosarcoma was made.

FIRST OPERATION (Jan. 27).—A vertical incision was made over the lateral side of the right thigh into muscle overlying the swelling. A quantity of what appeared to be blood-clot was evacuated and the wound was closed around a small drain.

Pathological Report (Professor H. A. Magnus).—The specimen consists of three large irregular pieces of hæmorrhagic tissue. One piece contains muscle and firm white

tissue which appears to be growth. Section shows a cellular tumour composed of two types of cell—a large acidophilic 'spider cell' and a small fusiform cell, also acidophilic. Sections stained by Heidenhain's iron-hæmotoxylin show longitudinal and transverse striations in a considerable number of the tumour cells (*Fig.* 729). Conclusion: Rhabdomyosarcoma.

After discharging blood for a few days the wound healed, but a swelling slowly appeared beneath the lower end of the scar. In view of the diagnosis an amputation was advised, but this the patient steadfastly refused.

SECOND OPERATION (Feb. 8).—This was carried out by Sir Cecil Wakeley. A large elliptical incision was made over the anterolateral aspect of the thigh, extending

FIG. 727.—Rhabdomyosarcoma of the right thigh. The swelling in the outer part of the quadriceps can be clearly seen.

from the level of the greater trochanter to just above the knee-joint. A wide excision of muscle containing the tumour was made, consisting mainly of the quadriceps and the anterior part of adductor magnus. The whole length of the femoral shaft was laid bare. After hæmostasis had been secured the wound was closed with drainage.

Pathological Report.—The specimen consists of an elliptical piece of skin 25 cm. long together with underlying muscle. Within the muscle is a tumour measuring 12 × 10 × 9 cm., with a partial capsule. There is extensive hæmorrhage and necrosis in the tumour. Section from the edge of the tumour shows growth with the structure of a rhabdomyosarcoma and much vascular granulation tissue, with large areas of hæmorrhage. For the most part the growth is well demarcated from the surrounding compressed muscle, but in one area transitional stages are seen between normal and malignant muscle-fibres.

The wound healed well and the patient was allowed up with the aid of a plaster-of-Paris splint applied from mid-thigh to mid-calf to keep the knee in extension. Her post-operative convalescence was marred by a small pulmonary embolus on the fourteenth day.

SUBSEQUENT COURSE.—Two months after operation a swelling began to appear again. This was fluctuant in part and 40 c.c. of blood-stained fluid was aspirated. Two or three weeks later a sinus appeared at the lower end of the scar and discharged blood-stained fluid. There were no glands in the groin and a chest radiography was clear, but X-ray examination of the thigh

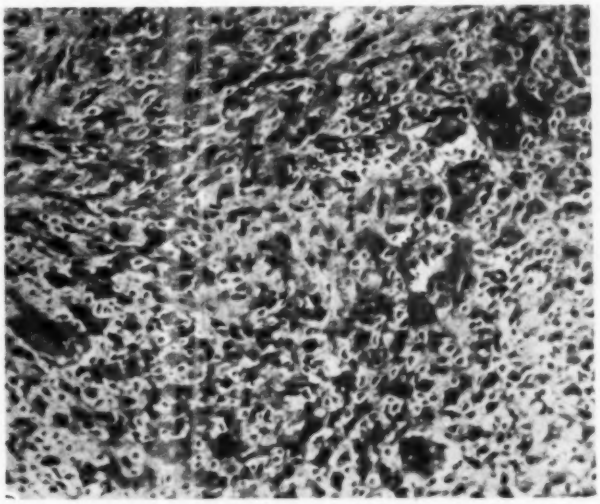

FIG. 728.—A section of the tumour. A representative field, showing the pleomorphic structure. (× 112.)

showed a little periosteal reaction beneath the tumour. Since the patient still refused amputation, the site of the tumour was curetted, but still continued to discharge.

June 2: The femoral artery was ligated below the inguinal ligament and the site of recurrence was once more scraped. Post-operatively the leg became cold and

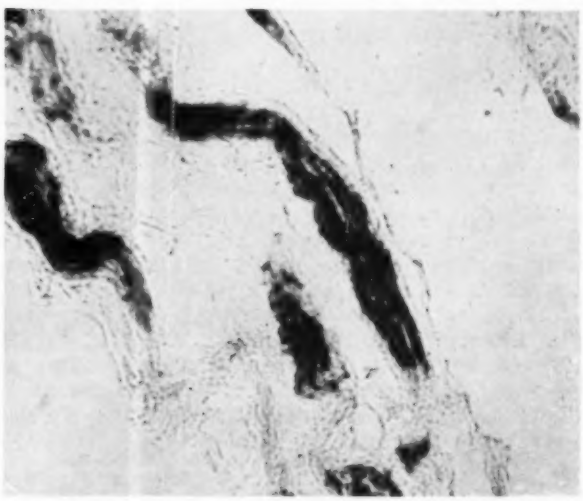

FIG. 729.—Tumour cells showing typical longitudinal and transverse muscle striation. (× 1120.)

anæsthetic, gradually developing signs of gangrene in the extremity. The patient's condition slowly deteriorated over the next two weeks until she died 7½ months after the first symptom and 4½ after diagnosis.

COMMENT

A short review of the English literature on soft-tissue sarcomata shows that rhabdomyosarcoma is one of the less common varieties. In a series of

153 cases reported by Sir Stanford Cade (1951) 7 were of this type. The French, and more particularly the Scandinavian, literature quote higher figures. Jönsson (1938) in material from Radiumhemmet stated that rhabdomyosarcoma were three times more common than other histological varieties after the age of 40 years, but four times less common before that age.

The pathology of these tumours has been adequately described by Cappell and Montgomery (1937) and their origin as well as that of other muscle tumours by Childs (1949). Cappell (1948) describes these neoplasms as being composed of very pleomorphic cells including the following varieties: (*a*) Spindle-shaped elements and tubular strap-like cells showing longitudinal and transverse striations in greater or lesser degree. These commonly show nuclei arranged in a compact row or two in tandem fashion. (*b*) Racket-shaped cells with a large nucleus in the rounded extremity and a long tapering process in which striations may be detected. (*c*) Rounded cells with scanty cytoplasm and a single large nucleus—highly anaplastic elements. (*d*) Giant cells often bizarre in shape and with many nuclei often with highly vacuolated cytoplasm and sometimes with abundant hyaline acidophil droplets.

In gross appearance they vary from case to case, but owing to lack of collagen they are characteristically soft and have a somewhat mottled pink and cream appearance with areas of hæmorrhage and necrosis, marked in some cases, such as in the one reported here. The appearance of encapsulation has been remarked on by many authors but this is in appearance only since microscopical examination shows it to be imperfect. For this reason there is a high incidence of local recurrence as demonstrated by this case. In Stout's series it occurred in 61 per cent. Invasion of the skin occurs and is followed by fungation, especially after biopsy or inadequate local excision. In this case and the two reported by Childs there was no clinical evidence of metastases. Contrary to the usual course of sarcomata, this occurs by both the blood and lymphatic streams, ultimately deposits being found in lungs, internal organs, and especially the vertebræ (Cappell and Montgomery, 1937).

There are no age limits, cases being reported from infancy to the ninth decade, but in the cases collected by Stout there was a preponderance in the fifth and sixth decades. In the cases from Radiumhemmet, where rhabdomyosarcoma is relatively more common, the oldest patient was 84 years.

The muscles of the lower limb, particularly the thigh, are most commonly involved. Less commonly the upper arm, back, and tongue. The hæmorrhagic nature and quick recurrence in this case fits with the short history of three months before presentation. This interval is typically short, of a few months only, but Stout mentions that a few cases have had a tumour allegedly for many years.

The main symptomatology consists in the presence of a lump and pain, since interference with function apart from some stiffness is minimal unless the tumour occurs close to a joint. The lump varies in size according to the rate and duration of growth. It is movable over underlying tissues, more so at right angles to than in the longitudinal axis of the muscles. Contraction of the muscle sometimes makes the tumour disappear but more often it appears more obvious and harder. The skin temperature may be raised. The occurrence of pain is late, although tenderness may be present earlier and probably indicates the involvement of nerve-fibres. The general condition of the patient is seldom affected at the first medical examination. Involvement of neighbouring bone is uncommon but does occur, as illustrated in the series of De and Tribedi (1940).

Rhabdomyosarcoma is regarded as a radio-resistant tumour. It is advisable for this reason to perform a biopsy to confirm the diagnosis and then to proceed to wide surgical ablation of the disease. In some situations this will fall short of amputation, while in others it is essential. The prognosis appears always to be grave. In the 121 cases collected by Stout (1946) there were only 4 presenting a 5-year symptom-free survival and of 20 cases followed for 3 years by Jönsson (1938) three remained symptom-free.

SUMMARY

1. A case of rhabdomyosarcoma of the thigh is reported in a patient of 84 years. This showed rapid growth and recurrence in spite of wide excision.

2. A brief review of the clinical picture and course of this disease is given.

I wish to express my thanks to Sir Cecil Wakeley for permission to report this case; to Professor H. A. Magnus for the pathological reports; and Dr. G. F. M. Hall for assistance with the photomicrographs.

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AN OSTEOCLASTOMA OF THE SKULL

By G. F. ROWBOTHAM

THE DEPARTMENT OF SURGERY, DURHAM UNIVERSITY

THOUGH osteoclastomata are well known tumours of the bones of the limbs and face, their occurrence in the skull is rare, only three cases having been described in the British literature during the present century. This case is of particular interest because observations were made over a period of years of its rate of growth, of its mode of spread and of its tendency to compress the brain.

A

B

FIG. 730.— Lateral radiographs showing the defect in the bone. A, Aug. 29, 1945. B, April 15, 1946. C, March 18, 1947.

CASE REPORT

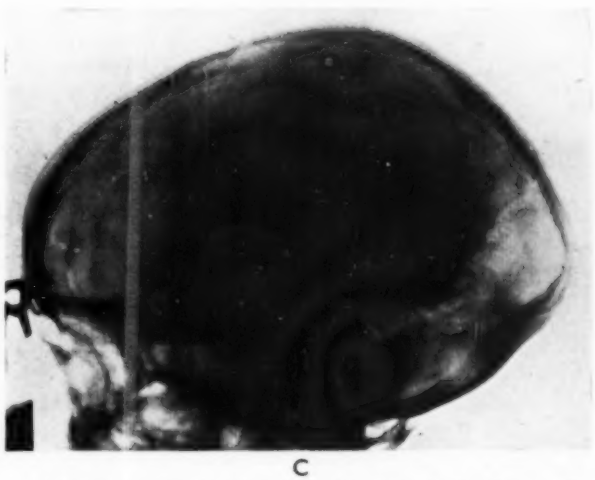
The patient was a young woman aged 23 years. In January, 1942, she noticed a stiffness in the right upper jaw with a tightness at the side of the head. A fortnight later a small swelling appeared in the right temporal region. During the next three years this swelling increased very little in size and was scarcely noticeable. In January, 1945, she developed lung trouble and a diagnosis of pulmonary tuberculosis was made by my colleague, Mr. George Mason, who treated her for this condition in his clinic at Shotley Bridge. Regarding her head she made very little complaint of pain, her main symptom being difficulty in clenching her jaw.

ON EXAMINATION (September, 1945).—There was a swelling beneath the right temporal muscle: its shape was that of a low circular mound about 1 in. in diameter standing about ¼ in. above the surrounding bone. Its surface was smooth, the soft tissues moved freely over it and there were no abnormal vessels in the overlying skin. In its centre the swelling was rubbery but not fluctuant; it did not transmit light. There were no swellings elsewhere in the body. There was no evidence of encroachment on the intracranial cavity; the Wassermann reaction was negative and the temperature normal.

Radiographs of the head showed a defect in the bone in the temporal region with clear-cut margins; there were no sequestra present. The radiological picture was much more suggestive of a neoplasm than of an osteitis (*Figs.* 730–732).

A dry tap was obtained on aspiration.

SECOND EXAMINATION (January, 1946).—There were no further symptoms. The swelling had increased in size, now measuring 1½ in. in diameter and standing ½ in. above the surrounding bone but the local characteristics of the swelling had not changed and there were still no signs of encroachment on the intracranial cavity.



C

After this examination the girl was admitted to a distant sanatorium for the treatment of her tuberculosis and she was not seen again until 15 months later.

THIRD EXAMINATION (March, 1947).—By this time the swelling on the head had increased enormously: its size and position are shown in the accompanying photograph (*Fig.* 733). Again the general characteristics of the swelling had not altered. There was no attachment to the skin and there was no fluctuation. The swelling was rubbery; its edges were ill-defined as they merged into the surrounding bone. There was now clear evidence of intracranial encroachment as shown by papillœdema and by a left-sided hemiparesis. The radiographs showed a marked enlargement of the bony defect in the temporal region, the general characteristics of the cut-out remained the same as on previous occasions. The walls were clean cut, suggestive of a neoplasm rather than of osteitis; a tangential view revealed a thin dome enclosing occasional stout trabeculæ. As it was now clear that we were dealing

with a neoplasm and as there was evidence of brain compression, it was decided to attempt to remove the tumour.

AT OPERATION (March 21, 1947).—Under general anæsthesia a U-shaped skin-flap was turned down. The skin was not unusually adherent and no abnormal vessels crossed from the swelling to the scalp. The temporal muscle and fascia were stretched thinly across the dome of the tumour. The temporal muscle was freed from its attachment and reflected downwards. Abnormal fibrous adhesions were encountered between the tumour surface and the muscle. The dome of the exposed tumour was hemispherical but with a nodular surface; the bone over the whole of the tumour was very thin and here and there were small irregular bony defects. At the bottom of these defects lay a fibrous membrane, no doubt the true capsule of the neoplasm. Because of obvious encroachment on the base of the skull no attempt was made to remove the tumour by a formal block resection. Instead, the thin dome of bone was broken into and nibbled away to the boundaries of the tumour. The tumour itself was enclosed in a fibrous membrane and this was freely opened. The tumour tissue itself was chiefly grey in colour but here and there purplish. By means of a spoon and similar instruments the tumour was easily removed piecemeal. Very little bleeding was encountered, and that which did occur was easily checked by diathermy or by light packing. The inner table of the vertex of the skull was thin and bulged into the intracranial cavity. At the base of the skull the bones had largely disappeared and the third division of the trigeminal nerve was seen clearly as it entered the pterygoid region. A thick fibrous membrane separated the tumour from the parotid gland and the pterygoid region. Here and there on its upper aspect the tumour had broken through its capsule to become attached to the dura mater. Several small areas of this membrane had to be excised but when these dural specimens were examined there was no evidence of tumour perforation. The surface of the brain itself was normal except that the cortex had been indented both from the side and from below. The dural defects were repaired with small fibromuscular grafts. As far as could be judged all tumour tissue had been removed. The scalp flap was stitched back into position without drainage. At the end of the operation the patient's condition was satisfactory. Convalescence was uninterrupted and she was discharged from hospital on April 24, 1947.

FIG. 731.—Tangential view showing thin bony dome of the tumour.

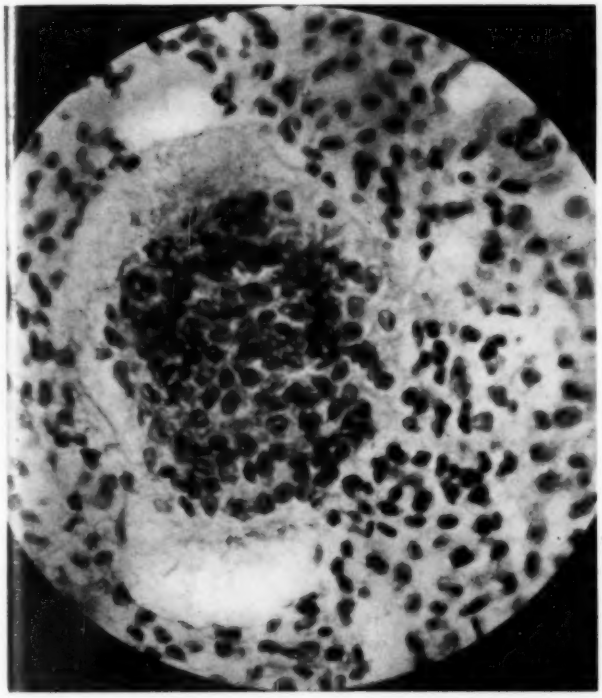
FIG. 732.—Tangential view showing thick bony trabeculæ within the bony dome of the swelling.

FIG. 733.—Clinical photograph taken on March 18, 1947.

On Jan. 26, 1948, the patient reported that she had had a peculiar attack in which she lost consciousness. On further inquiry it soon became obvious that she was suffering from major epilepsy.

On Feb. 19, 1948, she was re-admitted to hospital for further investigations. Locally there was no evidence of a recurrence. Moreover, there was no neurological evidence of compression of the brain. Air encephalogram

showed the ventricles to be normal in size, shape, and position. No doubt her attacks of epilepsy had been due to damage to the cerebral cortex either by compression or at operation when pieces of the dura mater had to be removed.



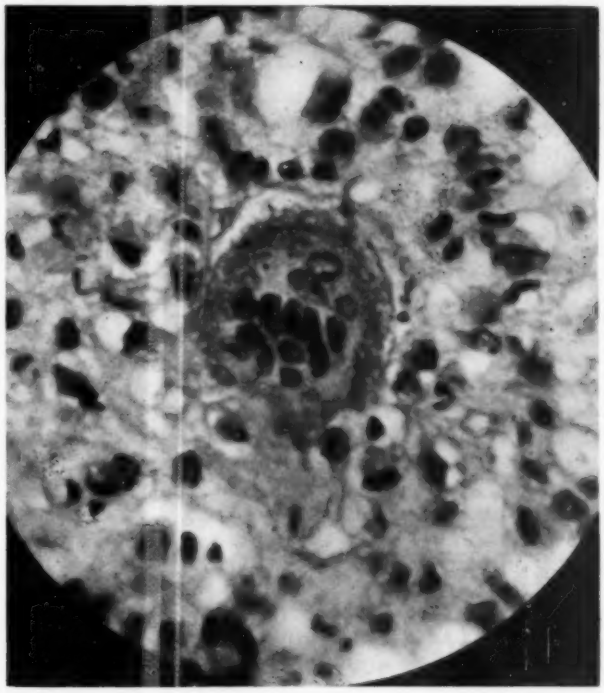


FIG. 734.—Typical giant cells. Stain—hæmatoxylin and eosin. (× 365.)

On March 3, 1950, my patient was admitted to the Glenlomond Sanatorium, under the care of Dr. B. W. Anderson, suffering from rapidly advancing bilateral pulmonary tuberculosis and she died on March 15, 1950. While she was in hospital there was no evidence of raised intracranial pressure or of any interference with cerebration until near the end. There was no local evidence of recurrence of the tumour.

Histological examination showed that the growth was a typical osteoclastoma. Areas of degeneration and necrosis were present and there were also some hæmorrhages and deposits of hæmosiderin. (*Figs.* 734, 735.)

As far as could be judged in this case the neoplasm arose within the two tables of the skull but whether from bone or other tissues, it is impossible to tell. Though the tumour presented itself first in the temple it might have originated in a basal bone and travelled to the vertex by the diploë. If the tumour, however, arose in the vertical part of the temporal bone then it is worthy of note that this bone develops in membrane. The bony dome of the swelling was not neoplastic in nature since its architecture was that of a normal bone. On the other hand the re-shaping of the outer table of the skull must have occurred as a result of the action of osteoclasts and osteoblasts since its curves were beyond the natural limits of bony elasticity. It is interesting to note that the tumour tended to form for itself a firm fibrous capsule and there was certainly little tendency for it to pierce the dura and to invade the brain. Indeed, the whole behaviour of the tumour locally was essentially benign; it was not highly vascular. There was never any sign of a secondary deposit elsewhere in the body.

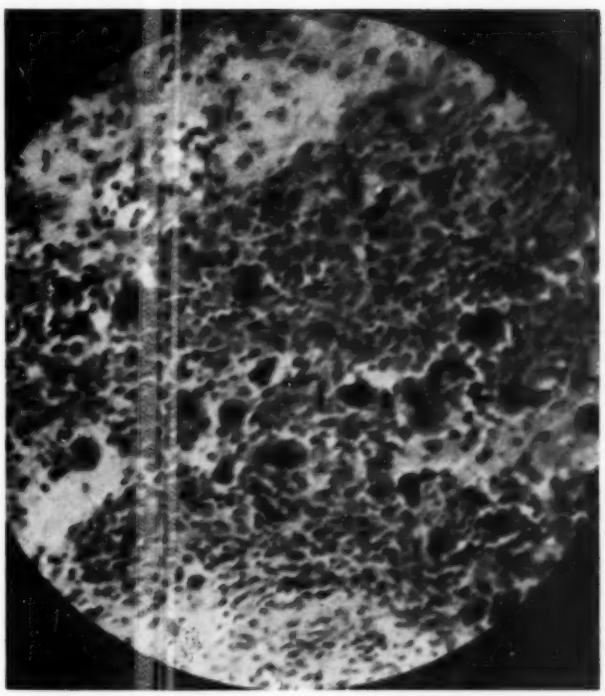


FIG. 735.—A cluster of giant cells within a cellular matrix. Stain—hæmatoxylin and eosin. (× 130.)

My thanks are due to Professors J. Greig Thomson and S. L. Baker for their help in the pathology of this case; to Dr. S. Josephs for his radiological reports and Dr. R. Whitehead for his help and criticism in the production of this paper. Again I would like to thank Miss N. Harvey for all the help she has given me.

NON-PARASITIC CYSTS OF THE LIVER

By FRANCIS E. STOCK
PROFESSOR OF SURGERY, UNIVERSITY OF HONG KONG

NON-PARASITIC cysts of the liver are a clinical entity of considerable rarity. The occurrence of 5 cases in the author's practice within a relatively short period is perhaps worthy of record. Numerous papers have been written on this subject in the past years, and most have recorded isolated cases. Until 1937 only 187 cases had been recorded (Davis, 1937). In the next five years a further 7 were added (Munroe, 1942). Maingot (1940) suggested approximately 400 as a total number of recorded cases including those of polycystic disease. Most authors differentiate between solitary cysts and polycystic disease, but nothing is known for certain about the aetiology of either and the only differences between the two conditions seem to be the number of cysts present and the fact that polycystic disease of the liver is frequently associated with similar disease of the kidney or pancreas. Stroesser and Wangensteen (1929) stated that " it is generally accepted that solitary cysts in non-arterosclerotic kidneys are but another expression of polycystic disease. The corresponding similarity would appear to extend to the manifestations of this disease ". In several cases reported of solitary cysts of the liver there have been small cysts in proximity to large ones.

Cysts of the liver can be classified in many ways, but in view of the uncertain aetiology a simple classification is probably the best :—

a. Pseudo-cysts :
  Traumatic—hæmorrhagic.
  Neoplastic—cystic degeneration.
b. True cysts :—
  i. Parasitic—hydatid.
  ii. Non-parasitic :—
    Polycystic.
    Retention.
    Lymphatic.
    Ciliated.

It is not proposed to go into detail in regard to most of these, for excellent descriptions can be found in various papers, including those of Boyd (1913), Moschowitz (1906), Wakeley and MacMyn (1931), Maingot (1940), and many others.

The clinical picture which these patients present is characteristically vague. Non-parasitic cysts are said to be four times as common in females as in males, and Maingot states that they are more common in children than in adults. In view of the infrequency of the condition and the vagueness of the symptoms, a correct pre-operative diagnosis will not often be made. In *Cases* 1, 2, 3, and 5, which were seen pre-operatively by the author, the clinical diagnosis was " duodenal ulcer with scarring ", " primary carcinoma of the liver ", " carcinoma of stomach ", and " non-parasitic cyst of the liver ". In *Case* 4, in which the abdominal section was performed by the gynæcologist, the pre-operative diagnosis was " ovarian cyst ". The patient may complain of dyspepsia, the presence of a lump, abdominal pain, or vomiting and hæmatemesis. A palpable lump is present in most cases and was found in three of the five cases reported here. When a lump is present, it is characteristically soft, and this finding was of value in making a diagnosis in *Case* 5. Radiologically a round soft-tissue swelling may be seen, and this may press upon and deform the stomach or the first part of the duodenum in a barium meal, as in *Cases* 1 and 3. The diagnosis may be confirmed by peritoneoscopy when a cystic swelling with a thin translucent trabeculated wall can be seen arising from the liver. This was only carried out in *Case* 5 of the series and provided confirmation of the diagnosis.

Treatment will vary from patient to patient and may be excision if the cyst is pedunculated, enucleation, wedge resection, marsupialization, or drainage if the cyst has a wide detachment. Enucleation is satisfactory provided the cyst is not too large, but hæmorrhage may be profuse. It was carried out with complete success in *Cases* 1 and 3, but it was an error of judgement when this method was applied to *Case* 4. In this case the patient was not seen by the author until the abdomen was opened and it was assumed that blood would be available for transfusion. Unfortunately this was not the case. Even then, however, the cyst was so large that a safer procedure would have been wedge resection followed by drainage. Wedge resection and drainage was adopted in *Case* 2 with satisfactory temporary results, while *Case* 5 was treated by marsupialization. Marsupialization and drainage is liable to be followed by a persistent discharging sinus, but in *Case* 5 the wound was completely healed within four weeks.

CASE REPORTS

Case 1.—E. M. (47/A7927), female, aged 53, British, was admitted to Broadgreen Hospital, Liverpool on June 23, 1947, complaining of vomiting blood the previous day —approximately half a pint of pure blood. She had not felt well the day before and complained of severe epigastric pain and pain in the left side for 24 hours.

PAST HISTORY.—' Gastritis ' three years previously. Treated by diet, but has not been on diet recently. Appendicectomy twenty years ago.

ON EXAMINATION.—General condition good. Tongue moist. Teeth false. Cardiovascular and respiratory systems normal.

Tenderness in the epigastrium and on left side of abdomen. No rigidity, no mass palpable, and liver not palpable, but a very small midline epigastric hernia was present. P.R., nil abnormal. A provisional diagnosis was made of peptic ulcer with hæmatemesis and epigastric hernia.

Barium meal : Juxtapyloric ulcer. Stomach emptied a little on the slow side. The patient was treated by diet and rest and subsequently discharged from hospital.

On Aug. 21, she was readmitted. The pain was now worse, but there were no fresh physical signs. Medical treatment was again initiated.

After a period of two weeks without much improvement the condition was reviewed and it was decided to

operate on the epigastric hernia and explore the abdomen. It was noticed at this time that the liver was palpable, but no mass could be felt.

PRE-OPERATIVE DIAGNOSIS.—Epigastric hernia and duodenal ulcer with scarring.

AT OPERATION.—Anæsthetic—cyclopropane, oxygen, curarine, cyclonal sodium. Midline epigastric incision. A small epigastric hernia was present surrounded by peritoneal fat. A large, transparent unilocular cyst was present in the right lobe of the liver and projected chiefly from the inferior surface. The stomach was entirely normal and the first part of the duodenum freely mobile. There was no evidence of any ulcer of the stomach or duodenum. It seemed probable that the cyst was pressing on the pylorus and first part of the duodenum and had given rise to the abnormal radiological appearance.

The cyst was enucleated by blunt dissection and the anterior margin of the liver sutured to the posterior margin

FIG. 736.—*Case* 2. Liver at post-mortem examination. Gross specimen. Multiple cysts are present.

of the cavity left by enucleation. There was moderate hæmorrhage which was controlled by suture. The wound was drained for 48 hours.

Convalescence was uneventful.

Sept. 20: Discharged.

Dec. 19: Condition satisfactory. Small incisional hernia now present. Not causing any symptoms. Has had no further bleeding or pain.

Case 2.—N. S. C. (209/51), male, aged 73, Chinese. June 30, 1949: Complaining of a painless swelling in right side of epigastrium for 3–4 weeks. No dyspepsia. No jaundice. No other symptoms except some loss of weight.

ON EXAMINATION.—General condition fair. Slight wasting. A large firm mass was felt in right upper quadrant continuous with liver. Dull to percussion, moving on respiration. No other physical signs.

PRE-OPERATIVE DIAGNOSIS.—Primary carcinoma of liver.

AT OPERATION (July 14).—Anæsthetic—pentothal, curare, gas and oxygen. Midline epigastric incision. Multiple cysts were found in the liver, the largest being 6 in. in diameter and containing straw-coloured fluid. The cyst wall was partially excised and the remainder drained. Liver biopsy was performed. Convalescence was uneventful.

Histological section showed gross disorganization of normal architecture. There was considerable dilatation of bile-ducts and also of the central veins of the lobules. The cyst wall was lined by a layer of epithelial cells, while the wall was composed of fibrous tissue. In the thickest part of the wall there were islands of liver tissue.

Dec. 30: Abdomen again enlarging and cysts palpable. There was some pressure on the transverse colon with gross displacement radiologically of the hepatic flexure.

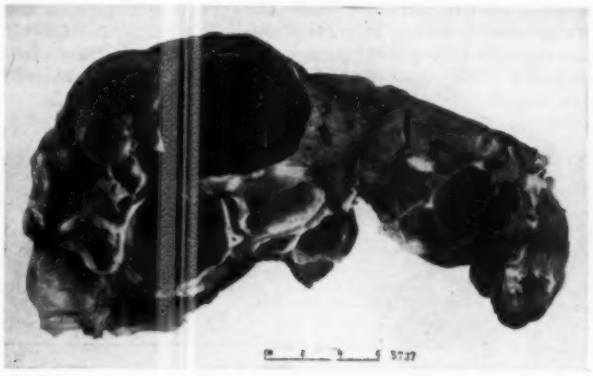


FIG. 737.—*Case* 2. Liver at post-mortem examination. Gross specimen sectioned. Multiple cysts are present.

March 18, 1950: Abdominal distension increasing. Vomited on several occasions. Refused investigation or treatment.

Jan. 8, 1951: Admitted to hospital *in articulo mortis*. Gross distension and dehydration Died 7 hours after admission.

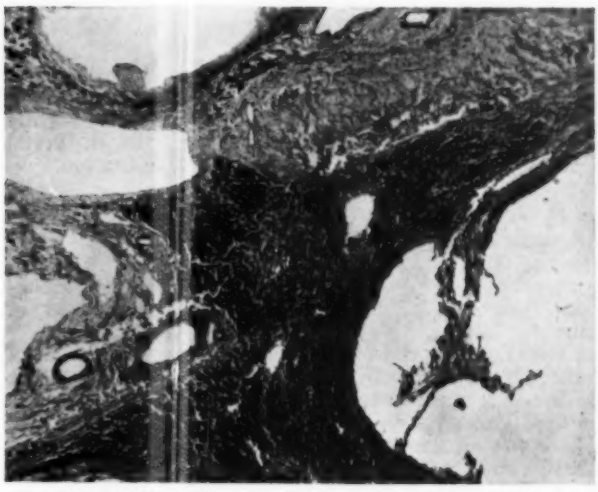


FIG. 738.—*Case* 2. Section of wall of cyst showing isolated liver cells in wall.

POST-MORTEM EXAMINATION (*Figs.* 736–738).—Multiple cysts of liver, kidneys, and mesentery; clonorchiasis of liver.

Primary disease: Congenital cysts of liver.

Cause of death: Intestinal obstruction.

Case 3.—W. P. K. (7310/49), male, aged 55, Chinese. Complaining of epigastric discomfort for seven months, continuous and unremitting. It could not be relieved in any way and was aggravated by taking food. No other symptoms.

ON EXAMINATION.—The patient was well developed and well nourished. The liver and spleen were not palpable and there was no abdominal tenderness.

R.B.C. 4,200,000, Hb 12·25 g., W.B.C. 6350. Fæces: no ova present.

Barium meal: Persistent filling defect in pyloric antrum. No local tenderness. Area of filling defect still mobile. No appreciable residue at five hours.

PRE-OPERATIVE DIAGNOSIS.—Early carcinoma of stomach.

AT OPERATION (Nov. 19).—Laparotomy. Anæsthetic—pentothal, curare, gas and oxygen. The stomach was entirely normal but the lesser curve was adherent to the under-surface of the liver. A small cyst 3 cm. in diameter was present in the liver at this point. It was thin-walled and obviously not parasitic in nature. The cyst was enucleated (*Fig.* 739) and the cavity filled with gelfoam

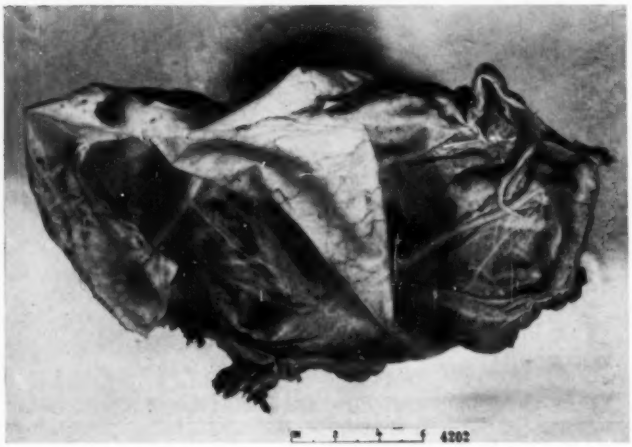


FIG. 739.—*Case* 3. The enucleated cyst—opened to show trabeculated wall.

and closed with sutures. No other cysts could be felt in the liver. Liver biopsy was performed and the wound closed.

Histologically the liver architecture was slightly distorted, with some round-cell infiltration in portal spaces. The liver cells show some fatty infiltration.

Case 4.—Y. L. C. (4378/50), female, aged 65, Chinese. Admitted to Gynæcological Unit of the Queen Mary Hospital on June 29, 1950. The patient complained of gradual enlargement of abdomen for four years. Palpitation, dyspnœa on exertion, and frequent attacks of coughing recently.

ON EXAMINATION.—Large cystic swelling, size of full-term pregnancy in abdomen; lower pole could be distinctly felt but not displaced upward; circumference of abdomen 93·5 cm. Symphysis to ensiform 30 cm. There was an area of resonance in the left flank. Elsewhere there was dullness.

Vaginal examination showed that uterus was normal. No definite connexion with abdominal mass could be demonstrated.

Examination of other systems: N.A.D.

Urine: Normal.

Blood: Hb 9 g.

Stools: Clonorchis ova present.

X-ray examination of abdomen: Soft-tissue swelling superimposed over pelvis and lower abdomen. Outline of cyst clearly seen. Appearance suggests ovarian cyst.

Pre-operative Diagnosis.—Ovarian cyst.

AT OPERATION.—Anæsthetic—pentothal, gas, oxygen, ether. The abdomen was opened and the cyst found to arise from the liver. The cyst was found to have a wide base but enucleation seemed practicable and was attempted. Hæmorrhage was profuse and no blood for transfusion could be obtained. Hæmostasis was secured but the patient collapsed and could not be resuscitated.

POST-MORTEM EXAMINATION.—Nothing grossly abnormal and death was due to hæmorrhagic shock. Histological examination of the liver showed that in some places the liver architecture was normal while in others it was completely disorganized by connective-tissue proliferation and mononuclear-cell infiltration. In some places there were areas of glandular tissue which had arisen by proliferation of bile-duct epithelium. Some of these ducts were very much dilated and the lumina were filled with desquamated epithelium, red blood-cells, and polymorphonuclear leucocytes. The largest cystic spaces were lined by cuboidal or flattened epithelial cells. The cysts had probably arisen from proliferation and dilatation of bile-ducts.

Case 5.—L. F. F. (6043/50), female, aged 54, Chinese. Admitted on Aug. 25, 1950, complaining of a mass in right upper abdomen for one year and slight loss of weight in recent months. No other symptoms.

ON EXAMINATION.—General condition good. Hb 12·2 g. A rounded mass 12 × 10 cm. occupied the right upper quadrant and moved on respiration. The mass was soft to palpation but not definitely cystic. It was dull to percussion and continuous with liver dullness.

X-ray examination of abdomen: Renal and psoas shadows normal. No other soft-tissue mass seen. No calculus seen.

CLINICAL DIAGNOSIS.—Mass arising in liver—probably cyst.

PERITONEOSCOPY (Aug. 8).—Anæsthetic—local. A thin-walled cyst was seen arising from the right lobe of the liver. Liver biopsy was performed.

Histological report: The section is composed of liver tissue. The normal architecture of liver is slightly distorted by increased amount of connective tissue in the portal spaces. The cellular infiltrations in the portal spaces are not prominent. The wall of the bile-ducts is much thickened. The lining cells are practically normal. The walls of the blood-vessels are also thickened, mostly confined to the intima. The liver cells show nothing remarkable. At places there are monuclear cells collected in groups among the liver cells. There is no parasite nor parasitic ovum found. It does not look like ordinary cirrhosis of the liver. It gives a picture of chronic inflammation.

AT OPERATION (Sept. 6).—Anæsthetic—pentothal, curare, gas, oxygen. A large thin-walled cyst was present occupying the greater part of the right lobe of the liver with a very wide detachment. Enucleation was not considered practicable. The cyst was opened and 50 oz. of dark brown thin fluid evacuated. Part of the cyst wall was excised and the remainder closed around a wide-bore drainage-tube. The tube was brought out through a stab wound beneath the right costal margin. The cyst wall was attached with nylon thread to the skin around the drainage-tube. The wound was closed without further drainage.

HISTOLOGICAL REPORT.—Wall of cyst: The section is composed of loose and dense connective tissue in which many blood-vessels and hæmorrhagic areas are found. Bile-ducts and nerves are also found. There are a few cells scattered here and there which look like atrophied liver cells or scattered about similar to liver cells found in cirrhosis. There is no lining cell found on either side of the cyst. It is hard to say if it is a cyst arising from dilated bile-duct. Since there is no lining cell or evidence of it being parasitic it is difficult to tell the nature.

SUMMARY

Five cases of non-parasitic cyst of the liver are reported. In four the cyst was solitary, while in the fifth multiple cysts were present. From reviewing the literature, however, there seems to be no evidence that the solitary and multiple cysts are of different aetiology, and it seems probable that all

rise from dilated bile-ducts. All five cases occurred in adults, although in the literature more cases seem to have occurred in children. Treatment by excision or enucleation is obviously ideal, but wedge resection and marsupialization is undoubtedly safer and the sinus so produced does not necessarily persist for a long period.

The author is indebted to Professor Hou Pao-chang, Professor of Pathology in the University of Hong Kong, for the examination of specimens in *Cases* 2, 3, and 4, for histological reports, and for the preparation of photographs; and to Professor Gordon King, Professor of Obstetrics and Gynæcology, who transferred *Case* 4 to his care.

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MULTIPLE EPIPHYSIAL DYSPLASIA

A REPORT OF FOUR CASES

BY J. KENNEDY WATT

ORTHOPÆDIC DEPARTMENT, GLASGOW ROYAL INFIRMARY

IT is thought desirable to place on record 4 cases of epiphysial dysplasia which appear to fit the lucid and comprehensive description of 'dysplasia epiphysialis multiplex', given by Sir Thomas Fairbank in the BRITISH JOURNAL OF SURGERY of January, 1947. In view of this article, it would be superfluous to describe the condition in detail, but a brief résumé is given as an introduction to the cases reported here.

Fairbank's description is based on a study of 20 cases, the outstanding features of which are as follows: The disease is usually first observed in young adults or children of either sex, and there is no hereditary or familial tendency evident in the majority of cases. They are of small stature, due to underdevelopment of the limbs rather than of the trunk, and are mentally and sexually normal. The common initial complaints are of difficulty in walking, or of pain in the hips or knees, the latter being clamant where secondary arthritis has developed. Radiological examination is the main basis of diagnosis and reveals that the epiphyses are symmetrically altered in shape, in sharp contrast with the normal appearance of the diaphyses. These epiphysial changes are most marked at the hips, shoulders, and ankles.

The four cases on which this article is based were noted particularly because they all first attended hospital within a period of just over one year. A search through the records of the Department over the last ten years failed to produce any similar cases.

CASE REPORTS

The features of these cases are as follows:—

Case 1.—N. S., female, married, aged 29 years. Height 4 ft. 11 in., weight 7 st. 10 lb.

This patient was first seen on Nov. 19, 1948, when she complained of mild pain and stiffness of both hips, which had been present for some years, and of occasional pain and stiffness of her right shoulder.

She was a small, well-built woman with relatively short arms and legs. Mental and sexual development were normal. Both hip-joints showed fairly good flexion and extension, but severe limitation of adduction, abduction, and rotation; abduction of her right shoulder was limited to 110° and of the left to 130°, but both had very little loss of rotation; all other joints were freely mobile and painless.

Radiography showed marked deformity of the femoral heads (*Fig.* 740) and of both humeral heads; the ankles

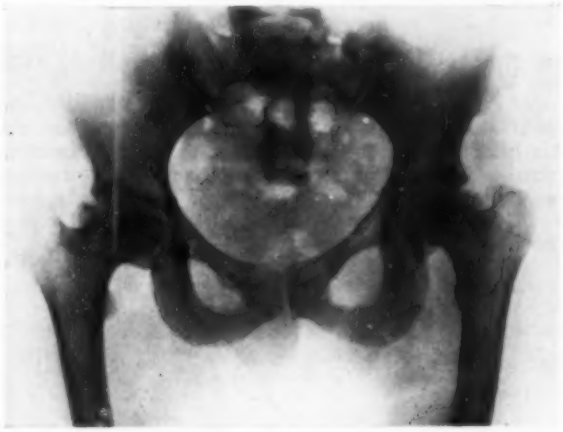

FIG. 740.—Pelvis of *Case* 1. Both femoral heads are distorted and irregular, the deformity being similar on both sides.

showed the irregularity and obliquity of the joint surfaces typical of the condition; and the knees had only mild epiphysial irregularities.

Unfortunately, it was not possible to arrange for further radiological examination, as, at the time of this investigation, she was pregnant and had so little trouble that she preferred not to attend for the requested radiographs. This emphasizes the incongruity between the severe bone changes and the mild clinical disability.

Case 2.—A. C., female, married, aged 30 years. Height 4 ft. 11 in., weight 8 st. 4 lb.

This lady, who was first seen in July, 1949, complained of severe pain and stiffness of both hips, which had increased in severity during the previous few years. She had no pain or stiffness in her other joints.

She was a small plump woman with short arms and legs, but of normal trunk development. Intelligence and

sexual development were normal. Movement of both hips, especially rotation, was greatly limited and forced

FIG. 741.—Left hip of *Case* 2. The femoral head is grossly altered in shape and appears to show a clear defect within the bone.

passive movement caused pain. Movement at all other joints was free and painless.

On radiological examination, gross symmetrical epiphysial changes were found at the hip, shoulder, and ankle-joint (*Figs.* 741–743). Apart from irregularity of the metatarsal heads, the bones of the foot were normal. The skull and vertebral column were normal. In addition to these characteristic changes, there was an area of osteochondritis dissecans in the left talus (*Fig.* 743).

FIG. 743.—Anteroposterior view of the ankles of *Case* 2. Note the characteristic obliquity of the talo-tibial articulation. An area of osteochondritis dissecans appears in the upper surface of the talus.

Case 3.—J. S., male, aged 20 years. Height 5 ft. 2½ in., weight 8 st. 2 lb.

This lad was seen on Feb. 1, 1950, when he complained of mild pain and stiffness of both hips of several years' duration. He had spent about eleven months in the Army, and was discharged on medical grounds because of 'Perthes' disease'.

On examination, he was a slim youth of normal proportions and gait. Flexion and extension of both hips

FIG. 742.—Left shoulder of *Case* 2. The humeral head is grossly deformed and the glenoid is altered in shape.

were good, but abduction, adduction, and rotation were severely limited and painful. All other joints were freely mobile and painless.

Radiologically, the heads of both femora showed a mild symmetrical irregularity without arthritic changes; the head of the humerus was somewhat flattened; the ankle-joint had the typical obliquity together with some

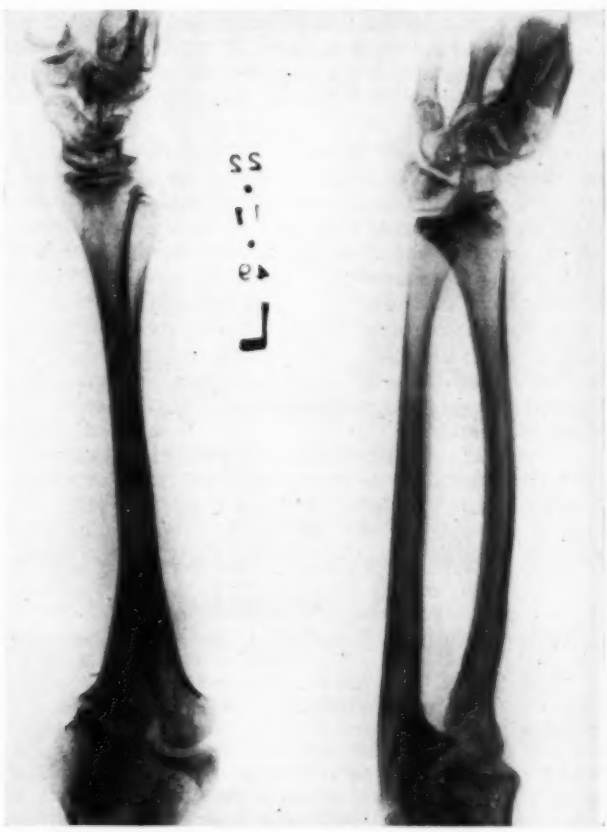

FIG. 744.—Left elbow and wrist of *Case* 4, with epiphysial irregularity at both joints.

irregularity of the talus; the medial and lateral femoral condyles were altered in shape; and the heads of the first and second metatarsals were flattened and distorted.

The important feature of this case is that he is the brother of *Case* 2 (A. C.), though all other members of the family seem to be normal. His condition was only discovered during inquiry into the family history of his sister.

Case 4.—R. McL., female, aged 14½ years. Height 4 ft. 4½ in.

This girl was seen in 1949, when she complained of deformity and limitation of movement of both elbows, which had been present for as long as her mother could remember.

She was a small child of poor physical development, but seemed quite normal apart from the elbow deformity, which was bilateral and symmetrical. Pronation-supination was limited to less than half normal range on both sides. Her fingers were spindle-shaped, and her feet small and broad, with a mild cavus deformity.

Radiologically, elbows and wrists showed gross epiphysial changes, accounting for the limitation of movement (*Fig.* 744). The head of the femur was flat and broad, and the head of the humerus was slightly flattened. Both feet were broad and stumpy, with a marked increase in the thickness of the first metatarsal and phalanges (*Fig.* 745).

The epiphysial changes in this case differ from those of the other three cases, but it is felt that the nature of these changes, their restriction to the epiphyses, and the symmetrical distribution justify the conclusion that this is a further case of multiple epiphysial dysplasia.

FIG. 745.—Anteroposterior view of both feet of *Case* 4. The first metatarsal and phalanges are thickened and the heads of the other metatarsals are altered in shape.

TREATMENT

Physiotherapy was given to the second and third cases with noticeable benefit. *Case* 1 did not desire active treatment in view of her domestic circumstances, and *Case* 4 was left alone in view of the difficulty of improving her pronation-supination range.

Physiotherapy probably gives adequate relief to most of these patients in the early stages, but the question of suitable operative treatment will have to be considered later when, it is expected, osteo-arthritic symptoms will be severe.

COMMENT

The striking feature of *Cases* 1 and 2 was the presence of gross deformation of the bony epiphyses, in direct contrast with the mild clinical disability. Indeed the second patient was treated for some time as a case of bilateral osteo-arthritis of hips because of the absence of symptoms in other joints. The correct diagnosis was made when the wrist was radiographed following a minor injury, and fragmentation of the scaphoid was found. When the other wrist was examined by X rays for comparison and the same abnormality discovered, the shoulder and ankle were examined and the changes noted above were revealed. In the light of this experience, it is suggested that any young adult, or child, with symptoms suggestive of osteo-arthritis of both hips and with a symmetrical deformity of the femoral heads, should be suspected of having this condition.

The area of osteochondritis dissecans in the talus of *Case* 2 (*Fig.* 743) is probably an incidental finding as other cases of osteochondritis of the talus investigated (four in number) showed no evidence of epiphysial dysplasia, and osteochondritis was not noted in any of Fairbank's cases.

Perhaps the most important fact recorded in this group of cases is the relationship between the second and third patients, viz., brother and sister. They are both typical examples of the condition and it would appear that some hereditary factor was at work in the production of the dysplasia in these cases.

This is not the first indication of a familial taint, as Fairbank includes in his own series a mother and son similarly affected, as well as two sisters of another family. He also states that Mr. J. A. Cholmely had given him details of two brothers with this condition.

Case 1 volunteered the information that her father had been a small man with a large body and short limbs and had had occasional trouble with his hips during his lifetime. Photographs, however, showed only his head and shoulders and confirmation of his daughter's statement could not be obtained.

However, it would appear that a hereditary factor is present in some examples of this condition, and it seems reasonable to postulate that the underlying factor in all cases is some inherited character leading to disturbance of epiphysial growth.

SUMMARY

Four cases of multiple epiphysial dysplasia (dysplasia epiphysialis multiplex) are presented, showing the characteristic symmetrical changes in the epiphyses of the long bones.

It is thought that a hereditary factor may account for the appearance of the condition.

My thanks are due to Mr. J. Patrick and the staff of the Orthopædic Department, Glasgow Royal Infirmary, for the facilities provided for studying these cases and for preparation of the radiographs.

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THE TECHNIQUE AND MANAGEMENT OF THE 'HINDQUARTER' AMPUTATION

By Sir GORDON GORDON-TAYLOR, K.B.E., C.B., and ROBERT MONRO
MIDDLESEX HOSPITAL, LONDON

Duris ut ilex tonsa bipennibus
. . . . . .
Per damna, per cædes, ab ipso
Ducit opes animumque ferro.*
HORACE, *Odes* iv, 4.

THIS contribution to the problem of the inter-innomino-abdominal amputation is concerned solely with the technique of the operation and with the pre-operative and post-operative measures that have been found most appropriate and valuable. For all other information relating to the amputation the reader is referred to previous papers by one of us in the BRITISH JOURNAL OF SURGERY and in the *Journal of Bone and Joint Surgery*.

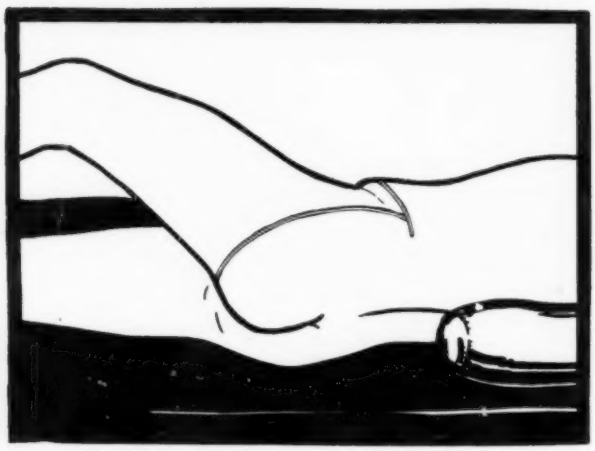

FIG. 746.—Position of patient and upper and posterior parts of the incision.

FIG. 747.—The initial manual exploration to ascertain operability (drapes omitted).

The series of hindquarter amputations performed by the Surgical Staff of the Middlesex Hospital now amounts to 64 cases, of which 58 have been performed by the older writer, assisted by his younger colleague in considerably more than half. From this unparalleled series the authors have reaped a bountiful harvest of experience in operative technique, and in pre- and post-operative management. The earlier fruits of this experience have been published in previous issues of this JOURNAL, but latterly an increased tempo and complexity of case have provided a number of valuable lessons, which have been amplified by numerous dissections in the post-mortem room and which, together with recent advances in ancillary surgical therapy, render it necessary to revise previous descriptions of the operation as performed by the authors.

Pre-operative management has kept in step with modern trends in preparation of patients for major operations. Instruction is given in breathing exercises, and pencillin and streptomycin therapy is started the day preceding operation. In view of the massive transfusion which on occasion has been necessary it has become customary to hold ten pints of matched blood in reserve, and to check the patient's Rh group as a routine.

Premedication is with omnopon and scopolamine, and the anæsthetic of choice is thiopentone, gas and oxygen. Stress is still laid on the advisability of unilateral spinal anæsthesia to block the effects of section of major nerves of the affected limb.

After being anæsthetized the patient is placed on the operating table lying on the side opposite to the lesion, and is turned slightly on to the back. The position is maintained by a support against the lower ribs and dorsal spine, well clear of the iliac crest, and by an assistant who stands at the far end of the operating table on the same side as the surgeon and holds the limb until the latter is amputated. The uppermost arm is supported on a rest such as is used for nephrectomy, and into its veins are inserted the needles of two separate pieces of drip transfusion apparatus. A sheet of oiled silk is stitched to cover and conceal the anus and a catheter passed; formerly the latter was tied in, but a Foley catheter is now employed. Finally an Esmarch bandage is applied to an appropriate level on the limb to be amputated to conserve the blood volume; the skin is widely prepared with cetavlon and tincture of iodine, and the patient draped.

The incision usually practised consists of two parts, anterior and posterior. The *anterior* is made

* Even as the oak, lopped by axes rude,
Through loss, through wounds, receives
New gain, new life—yea from the very steel.
LORD LYTTON.

initially, and lies immediately above the inguinal ligament (Poupart's ligament), being prolonged upwards and backwards just above the iliac crest to an extent which varies with the point at which it is intended to divide the pelvic girdle, and is also carried downwards across the pubic tubercle into the crease between the adductor region of the thigh and the perineum. The *posterior* part of the skin incision is made later in the operation, but is conveniently marked out with 'Bonney's blue' at the bone in the median plane often provides a valuable guide to the exact position of the symphysis.

The external iliac artery is now identified and followed upwards, peritoneum and ureter being pushed medially until the common iliac vessels are exposed. The psoas is divided outwards from this point until the obturator nerve under which the iliolumbar vessels lie is seen, thus facilitating the exposure of the common iliac vessels. The common iliac artery is ligated and divided, the iliolumbar vein

FIG. 748.—Exposure of the common iliac arterial bifurcation.

FIG. 749.—Exposure of the common iliac and ilio-lumbar veins.

commencement; it runs from the upper and posterior part of the first incision downwards, with a considerable convexity forwards in front of the great trochanter, subsequently winding around the posterior aspect of the upper thigh to meet the lower end of the anterior incision in the vicinity of the ischial tuberosity.

Firstly, the anterosuperior incision is deepened through the abdominal musculature above the iliac crest and in the groin, and the peritoneum is pushed medially from the iliac fossa and pelvic brim so as to ascertain at the earliest moment the operability of the lesion. The spermatic cord is next mobilized and displaced medially; the deep epigastric vessels are secured; the insertion of the ipsilateral rectus abdominis is divided, exposing the symphysis pubis; the bladder is separated from the back of this bone and protected by a pad, and the symphysis is divided with a knife; sometimes its complete dislocation at a later stage may require a little levering with a chisel. A ridge on the posterior aspect of the pubic

or veins are secured, and the common iliac vein mobilized, ligated, and divided. The whole lower vascular pedicle is then pushed gently downwards until a finger can be introduced lateral to and above it into the apex of the sciatic notch.

The patient is now rolled very gently into the full lateral position and the posterior skin-flap cut. Where the ilium is not involved, the gluteus maximus is also in part reflected in the skin-flap, and the gluteus medius divided so as to expose the apex of the sciatic notch posteriorly; a pair of cholecystectomy forceps is then thrust through the notch from behind, forwards and upwards into the pelvis, emerging above and behind the distal segment of the divided vascular pedicle; by means of the forceps a Gigli saw is drawn through the notch and used to divide the ilium upwards and outwards to the junction of the middle and posterior thirds of the iliac crest.

The pelvis can now be opened out, the patient being rolled dorsalwards; the pelvic viscera are

pushed medially, the levator ani is divided, and the crus penis and urogenital diaphragm are detached from the pubis. The laterally directed branches springing from the internal iliac vessels and comprising the external iliac, obturator, superior and inferior gluteal, and internal pudendal vessels are secured; the sacrotuberous and sacrospinous ligaments are divided and the amputation is completed by severing the pyriformis and the sciatic nerve. Bleeding points are secured, and the wound is

FIG. 750.—Posterior exposure of the great sciatic notch for iliac bone section.

closed by suturing the gluteus maximus to the anterior abdominal musculature and coaptating the skin edges.

The chief developments in the technique of the operation have concerned the division of the posterior segment of the pelvic girdle, for in no fewer than nine of the last twenty cases it has been necessary to section the girdle through the sacro-iliac joint rather than more laterally through the ilium. The operative mortality for sacro-iliac disarticulation in this series has not conspicuously differed from that for iliac section, but mortality figures alone do not reflect a true comparison of the severity of the two procedures, and sacro-iliac disarticulation is unquestionably a more difficult and anxious operation. However, the technique more recently developed renders sacro-iliac disarticulation not impracticable in even the most unpromising patients, and when applied to the more favourable group of cases suitable for iliac section renders this procedure comparatively straightforward.

The chief hazard encountered in the division of the posterior segment of the pelvic girdle is hæmorrhage from the iliac vessels and their immediate branches; the thin-walled iliac veins in particular are easily damaged. The danger is best avoided by observing the following points of technique:—

1. Elective ligation of the common iliac vessels.
2. Division of the symphysis pubis prior to embarking on the posterior section of the girdle.
3. Use of a Gigli saw and avoidance of the chisel.

FIG. 751.—Posterior exposure of posterior iliac spinous region and posterior limit of sciatic notch for sacro-iliac section.

Ligation of the common iliac vessels is of course obligatory where sacro-iliac disarticulation is contemplated, and convenient where iliac section is proposed. In the latter group separate ligation of the external iliac vessels and of the posterior division of the internal iliac vessels is possible and was formerly advocated, but this is unnecessarily complicated and would seem to confer no advantage, since common iliac ligation has provided more certain hæmostasis when the gluteal flap has been cut, and has not resulted in ischæmia of the pelvic viscera or in any significant impairment of vitality of the posterior skin-flap. In cases where the posterior flap has sloughed subsequent to operation, the determining factor has been rather that the flap has had to be cut thin on account of posterior extension of the growth on to the dorsum ilii, or because the tumour has already been hopefully but unavailingly irradiated.

Certain precautions have been found essential for sure and satisfactory common iliac ligation. First,

the psoas is divided transversely opposite the common iliac vessels, which are then approached from the lateral aspect with much greater ease. After ligation and division of the common iliac artery, it is imperative next to *secure the iliolumbar vein or veins*, which drain into the common iliac vein; once this is accomplished the common iliac vein is readily mobilized and encircled with ligatures carried on aneurysm needles. Unless the iliolumbar vein is secured this short vessel tethers the common iliac vein to the pelvic brim, and is very easily torn from the main vein if inadvertent and untimely efforts are made to ligate the latter first; the hæmorrhage which results is extremely difficult to control and greatly hampers ligation of the main vein.

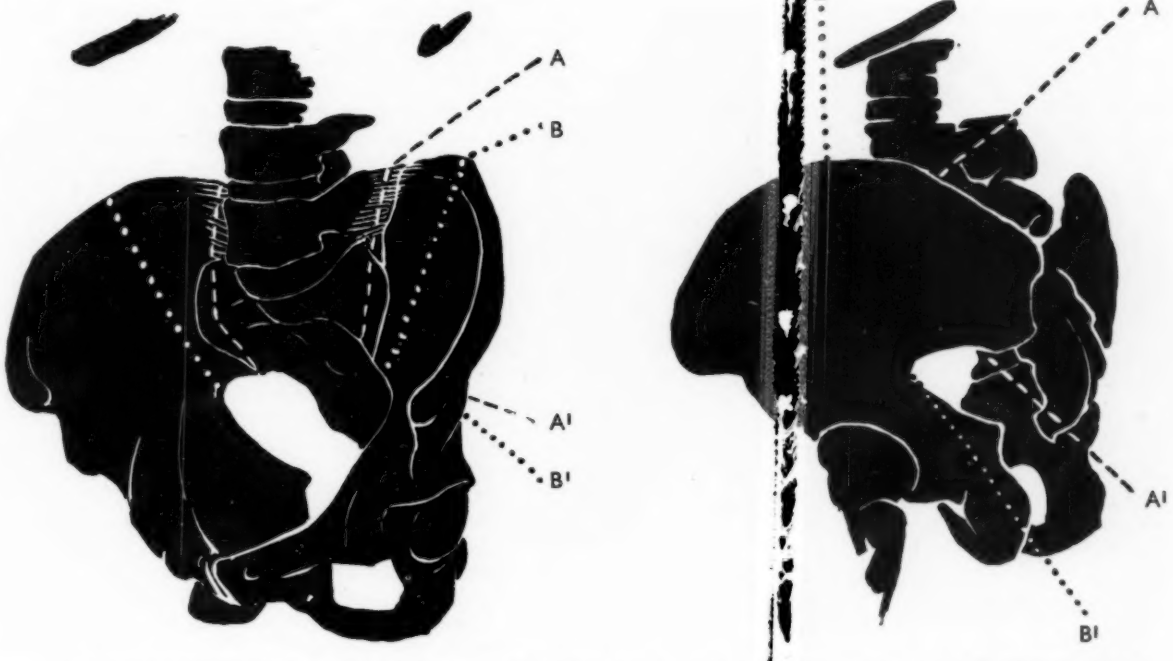

FIG. 752.—Diagrammatic views of bony pelvis, showing line and direction of cut with Gigli saw. A-A¹ sacro-iliac section; B–B¹ iliac section.

Division of the symphysis pubis should be completed before any attempt is made to divide the posterior segment of the pelvic girdle. In the course of the latter procedure, even when carried out with a Gigli saw, some laceration of the superior gluteal veins is almost inevitable, and although the iliac vessels have already been ligated, fairly brisk hæmorrhage may take place. If the symphysis has already been divided the whole pelvis can usually be opened out like an oyster shell as soon as the posterior bone section is completed, and hæmorrhage is readily controlled by simply pressing on swabs placed over the pelvic viscera, no further hæmostatic steps being necessary until the amputation has been completed. On the other hand, if the pelvis cannot be opened out because of postponed division of the symphysis, the hæmorrhage following posterior bone section is difficult to control and a considerable volume of blood may be lost before the symphysis can be divided and separated.

For section of the posterior segment of the pelvic girdle no instrument is more safe or more efficient than the *Gigli saw*; other forms of saw cannot be conveniently introduced, while chisels easily slip and cause disastrous damage to the nearby iliac veins. The Gigli saw can be introduced satisfactorily even in cases where exuberant growth overhangs and obscures the sacro-iliac joint anteriorly, and can even be made to cut through the ala of the sacrum with safety.

Where the ilium is not itself involved by growth and section of the dorsum ilii suffices, the Gigli saw is easily introduced after reflection of the gluteal flap and division of the gluteus medius down to the bone on a line from the junction of the middle and posterior thirds of the iliac crest to the angle of the sciatic notch.

Where sacro-iliac section with complete removal of the ilium is required, the posterior flap must be reflected farther back so as to expose the posterior iliac spines and the sheath of the erector spinæ; the flap consists of skin and subcutaneous tissue only, the gluteus maximus being left undisturbed. The erector spinæ aponeurosis is divided immediately behind the posterior iliac spines and gives a clear indication of the required line of section. The incision is continued in its lower part into the origin of the gluteus maximus, and splits the muscle in the line of its fibres immediately below the posterior inferior iliac spine. The lower end of the Gigli saw is introduced in a manner similar to that already described, except that the forceps are thrust through the sciatic notch as close to the margin of the sacrum and sacrotuberous ligament as possible, rather than at the apex of the notch.

Superiorly, the iliac crest is cleared completely by detaching the quadratus lumborum and erector

spinæ. The upper end of the Gigli saw can then be brought over and round so that the saw lies snugly in the iliolumbar angle and across the anterior aspect of the sacro-iliac joint, dividing the iliolumbar ligaments and the pelvic girdle in the plane of the sacro-iliac joint.

Occasionally the upward spread of a massive neoplasm such as a chondrosarcoma of the ilium has obliterated the whole space between ribs and iliac crest. Sacro-iliac section is still achieved, but instead of the iliac crest and iliolumbar angle being cleared above as a preliminary to the saw cut, a modified Steinmann pin is thrust from before backwards through the interspace between fourth and fifth lumbar transverse processes; the upper end of the saw is attached to the butt end of the pin, and is drawn through to the back, so that once more the saw lies across the front of the sacro-iliac joint, its two ends projecting posteriorly.

FIG. 753.—General view of pelvis opened out after sacro-iliac section.

POST-OPERATIVE MANAGEMENT AND COMPLICATIONS

Apart from the routine use of penicillin and streptomycin, routine postural pulmonary drainage, and breathing exercises there has been little alteration in post-operative management from the accounts already published. But in cases of comparable severity there is no doubt that post-operative recovery has been very much smoother and more rapid than in the earlier patients in whom this amputation was undertaken, and while improvement may have been in part attributable to alterations in post-operative management, it has also undoubtedly been due in great measure to experience and to improvements in operative technique.

The average period of post-operative hospitalization in our series has been fifty-nine days. The longest period was one hundred and twenty-three days, the shortest twenty-six days. The uncomplicated case may be expected to be fit for discharge four to six weeks after operation.

The operation has not been exempt from *post-operative complications*. Some degree of shock is usual, but with unilateral spinal anæsthesia, adequate transfusion, and improvements in operative technique it is no longer so fearsome a feature.

Although torrential primary hæmorrhage has been encountered on more than one occasion, and is particularly liable to complicate sacro-iliac section, reactionary hæmorrhage of a severity to necessitate re-exploration of the wound has only occurred once, and secondary hæmorrhage never.

Retention of urine is met with in all cases for the first forty-eight hours, though most patients are able to micturate on the third day. Obstinate retention occurred in 8 cases; 4 of these were young and the retention spasmodic, persisting only a few days longer than normal. Three elderly men developed prostatic retention, one recovering without further operation, another eventually getting over his retention, but requiring a one-stage prostatectomy a few months later, the third requiring suprapubic catheterization and a subsequent endoscopic resection; one man with an enormous tumour invading the sacrum developed an incomplete temporary paralytic retention after a necessarily very medially placed posterior bone section with a chisel had damaged his spinal theca.

There have been other urinary complications of interest; in one young patient the prostate had to be removed at the primary amputation, since it had become infiltrated by a chondrosarcoma arising from the superior ischiopubic ramus. The bladder base was stitched around a Foley catheter to the membraneous urethra and on removal of the catheter three weeks later, there was comparatively little impairment of urinary control (!). Some œdema of the penis is commonly encountered, but only one has been of a degree to require a 'dorsal slit'. A delayed ureteric fistula developed in one case (the sacro-iliac joint had been disarticulated with a chisel), but healed spontaneously. Serious sulphonamide crystalluria occurred in three cases in the early days of chemotherapy and was possibly responsible for a fatal renal failure in one case.

Mortality.—There have been 14 operative deaths in a series of 64 amputations, a mortality of 22 per cent. It is interesting to note that 18 amputations were carried out in patients over the age of 50, with 4 deaths. The deaths have mainly been attributable to shock and hæmorrhage, but

there has been a notable reduction in mortality in the last decade, even though a higher proportion of the amputations in this period have demanded the more dangerous sacro-iliac disarticulation—only one quarter of the cases prior to 1940 required such disarticulation, whereas after 1940 it was necessary in one-third.

The authors offer their tribute of laurel for honour to the surgeons on both sides of the Atlantic who with a far more limited experience of the operation than themselves have yet achieved one hundred per cent recovery rates in their various series; but the experience of the older writer goes back to an almost primæval surgical era which lacked much that is commonplace to-day. Moreover, mortality percentages are often some index of a surgeon's attitude towards patients suffering from malignant disease, especially the 'bad surgical risk'; they are not necessarily indicative of his shortcomings and lack of skill.

RESULTS OF HINDQUARTER AMPUTATION

Number of amputations	64
Number alive to-day	25
Number surviving more than five years	12

With one exception all these amputations were performed for malignant disease.

HINDQUARTER AMPUTATION—MORTALITY FIGURES

CATEGORY	TOTAL CASES	DEATHS	PERCENTAGE MORTALITY
Total of hindquarter amputations	64	14	22
Amputations prior to 1940	11	4	36
Amputations since 1940	53	10	19
Amputation with sacro-iliac disarticulation	17	5	29
Amputation with iliac section	47	9	19

HINDQUARTER AMPUTATION POST-OPERATIVE MANAGEMENT

Before leaving Theatre

Dry dressing and wool are retained by a complete covering of elastoplast.

The patient is lifted from the table and placed in bed and a further covering of wool and a binder applied.

The patient is returned to the ward on an inclined plane lying on his back, the bed being heated and having an electric blanket and dunlopillo or water-bed mattress.

Early Ward Regimen

Bed raised on blocks (12 in.), which are lowered gradually after 2 hours as patient's condition permits.

Observation:—¼-hourly pulse—½-hourly B.P. for 6 hours.
½-hourly pulse—1-hourly B.P. for 6-12 hours.
1-hourly pulse after 12 hours for 1st and 2nd days.

Maintain fluid intake intravenously.

Self-retaining catheter—straight drainage into bottle.

Procaine penicillin and streptomycin continued twice daily until after drains removed.

1st and 2nd Days

Low lateral Fowler position alternating good side, back, bad side.

4-hourly drill.

(*a*) change of position
(*b*) back drill—removing binder on first occasion, remember the heel
(*c*) postural drainage—slapping and breathing exercises (roll both sides).

Scrotal support with sandbag.

Sandbag under the foot.

Fluids by mouth as desired as soon as conscious. Balance maintained with intravenous fluids.

Food—if and as desired on 1st day.

Opiates are required initially, but seldom after 48 hours.

3rd Day

Glycerin enema if bowel sounds present.

Intravenous fluids stopped.

4th Day

Catheter removed.

5th Day

First change of dressing in theatre.

Usually under omnopon and scopolamine analgesia supported with thiopentone and gas and oxygen if necessary.

Drains shortened.

6th Day

Movements up and down bed as well as rolling encouraged.

7th or 8th Day

Redressing in ward (an abundant serous ooze is to be expected).

Drains shortened or removed according to ooze.

14th Day

Stitches out—may be left longer if tension considerable.

Wound may be redressed between 7th and 14th days if moist; this is usually necessary.

Paint suture line with 1 per cent gentian violet in spirit.

18th Day Onwards

Up for bedmaking if fit. Wound supported with binder.

Activity increased—training in use of crutches given.

Discharge after 4 to 6 weeks to be anticipated.

Our most grateful thanks are due to Miss Hewland, whose illustrations are an adornment of the paper.

CARCINOMATA DEVELOPING AT THE SITE OF FOREIGN BODIES IN THE LUNG

By A. H. M. SIDDONS and A. M. MacARTHUR

This paper records two cases of carcinoma of the bronchus occurring at the site of retained metallic foreign bodies. In both cases the foreign bodies were war missiles and the patients died of carcinoma 32 and 35 years after injury. In one the diagnosis was not proven histologically.

CASE REPORTS

Case 1.—A. B., male, admitted to hospital in March, 1949, at the age of 56.

History.—Wounded 32 years previously; shrapnel ball entered right shoulder and retained in right lung. Only symptoms subsequently occasional pain in the chest and chronic bronchitis, which persisted and for which a pension was given. One week before admission developed fever, cough with purulent sputum, loss of weight, and increasing breathlessness. Physical signs at this time suggested bronchitis with some bronchospasm and early cardiac failure. Symptoms improved with one month's in-patient medical treatment.

Readmitted in July, 1949, with recurrence of symptoms, considerable quantity purulent sputum, which had once been bloodstained.

Chest radiographs at that time (*Figs.* 754, 755) show the shrapnel ball, and anterior and above it a lung abscess with a fluid level. Subsequent dissection showed this abscess to be lined with carcinoma and to occupy the whole of the middle lobe. This lobar distribution accounts for the sharply defined limits of the shadow.

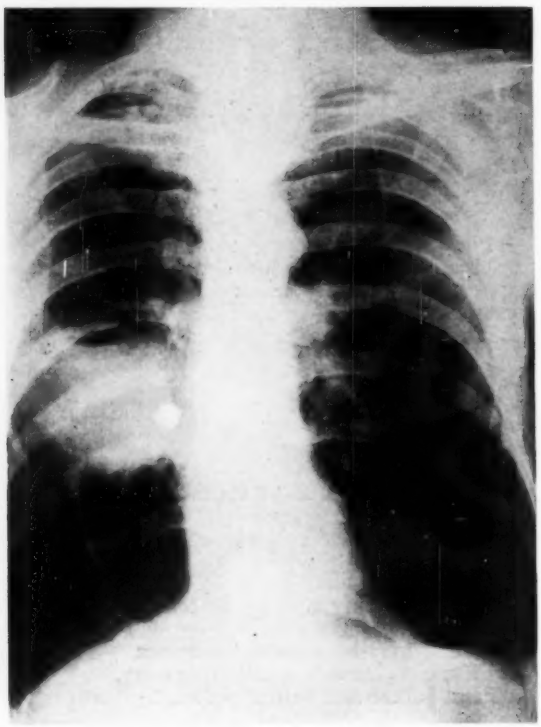

Fig. 754.—*Case* 1. Postero-anterior radiograph of chest, July, 1949. Showing shrapnel ball and abscess with fluid level.

Fig. 755.—*Case* 1. Right lateral view, July, 1949.

Bronchoscopy.—Carcinoma seen at orifice of middle lobe bronchus, confirmed by biopsy, August, 1949.

Dissection Pneumonectomy.—A portion of pericardium involved with growth was excised. The post-operative course was stormy and complicated by the early appearance of a bronchopleural fistula and empyema requiring pleural drainage.

October, 1949: Discharged home in poor condition with tube drainage of the pleural space.

December, 1949: Died at home, presumably of toxæmia with cardiac failure—no clinical evidence of metastases of carcinoma. There was no post-mortem examination.

Operation Specimen (*Figs.* 756, 757).—The lung contains a shrapnel ball just below the origin of the middle lobe bronchus. The middle lobe is almost completely replaced by carcinoma, the centre of which is excavated into an abscess. The orifice of the middle lobe bronchus is completely blocked by neoplasm, which histologically is of the squamous-cell type (*Fig.* 758).

Case 2.—G. A., male. Reported to Chest Clinic in February, 1948, at the age of 57, complaining of pain in the right chest.

History.—In 1914 wounded by a bullet which was retained in the right lung. Radiographed in 1942 as a contact with his brother, who had phthisis. This radiograph (*Fig.* 759) showed no abnormality in the lungs other than the bullet surrounded by a fibrous capsule.

He was free from chest symptoms until six months prior to admission, when he started to have pain associated with cough and sputum which was never bloodstained; there was also sweating at night and loss of 2 st. in weight in a few months. At that time there were signs suggesting consolidation of the right upper lobe. Chest

FIG. 756.—*Case* 1. Lung specimen. Medial aspect right lung. Arrow shows shrapnel ball.

FIG. 757.—Radiograph of injected lung specimen. The bronchi have been partially filled with opaque material. The position corresponds with *Fig.* 756 and shows the relation of the foreign body to the middle lobe bronchus and the abscess.

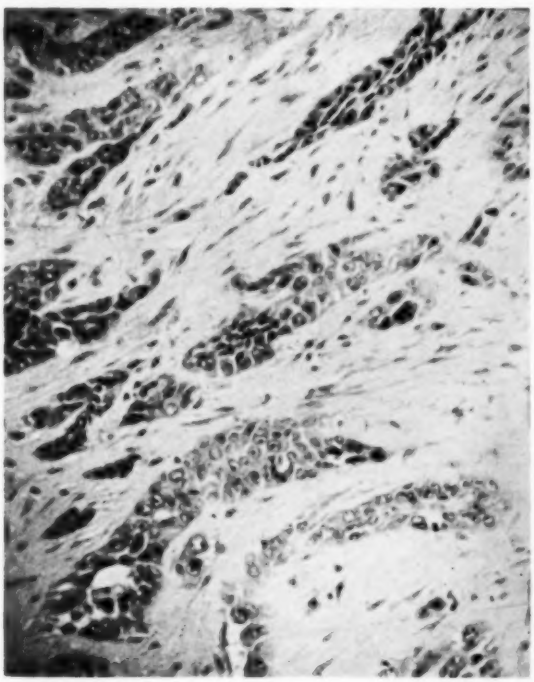

FIG. 758.—*Case* 1. Squamous-celled carcinoma adjacent to foreign body. (× 120.)

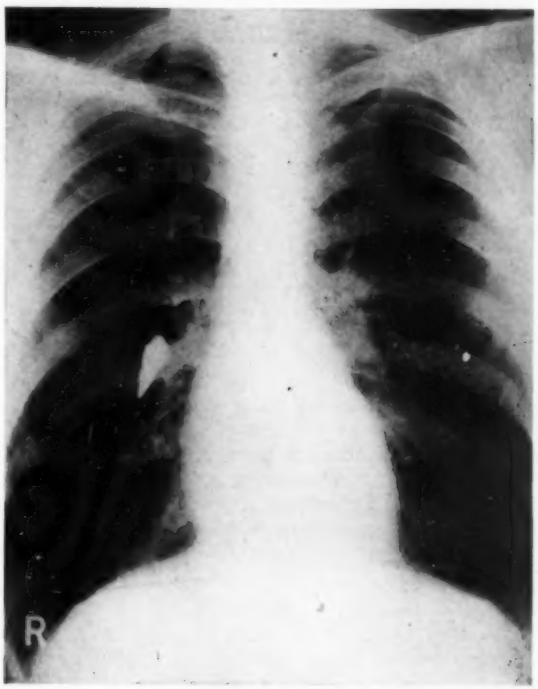

FIG. 759.—*Case* 2. September, 1942. Film shows a fine fibrous capsule around the bullet.

radiography (*Figs.* 760, 761) showed a contracting upper lobe containing infiltration typical of carcinoma.

Bronchoscopy was recommended but refused.

July, 1949: Reported again in much worse condition. Radiograph of the chest now showed further shrinkage of the infiltrated right upper lobe, with involvement of the lower lobe. (*Figs.* 762, 763.)

August, 1949: Bronchoscopy revealed that the right upper lobe bronchus was completely occluded by a mass extending up into the trachea. The appearances were

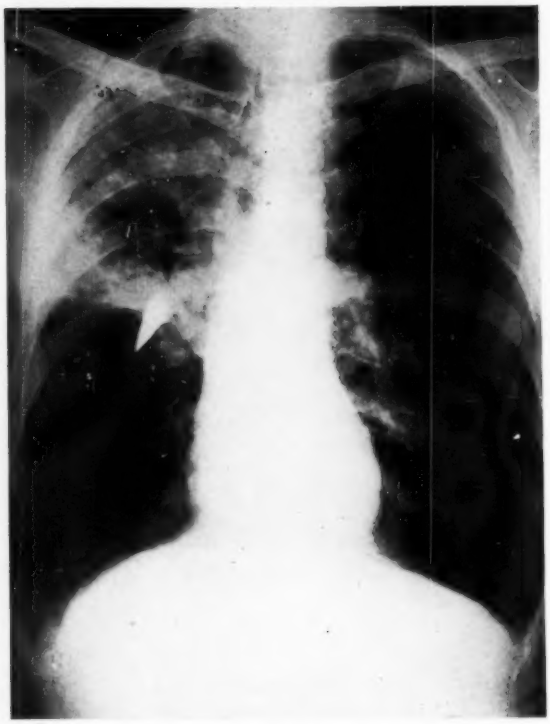

FIG. 760.—*Case* 2. Postero-anterior radiograph. February, 1948.

FIG. 761.—*Case* 2. Right lateral view. February, 1948.

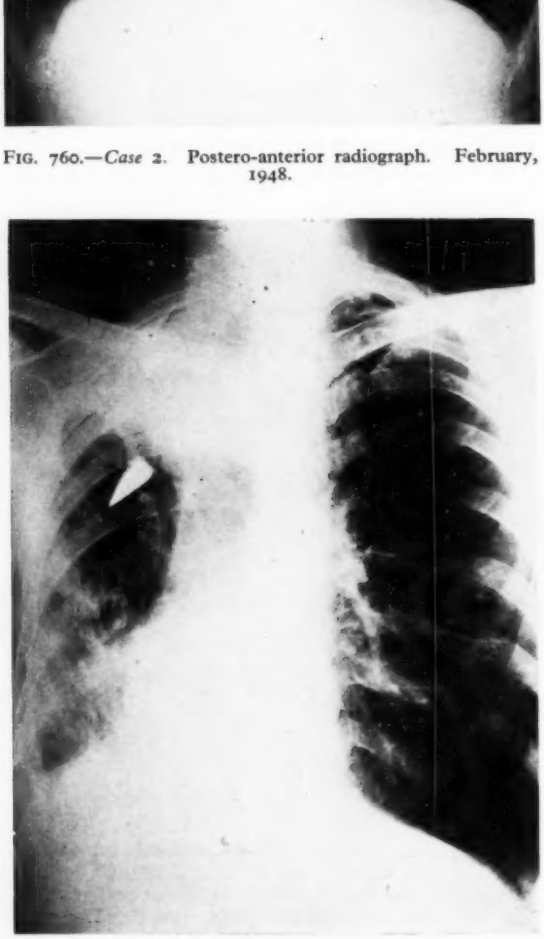

FIG. 762.—*Case* 2. Postero-anterior view. June, 1949.

FIG. 763.—*Case* 2. Right lateral view. June, 1949.

characteristic of carcinoma. An attempt at removal of a piece for biopsy was made, but no satisfactory tissue was obtained.

September 1949: He died at home. There was no post-mortem. The bullet is seen in the radiographs to lie largely in the middle lobe, but to extend into the upper lobe in which the neoplasm developed. It seems reasonable to infer that the radiographic appearances with progressive shrinkage of the lung were due to carcinoma. The bronchoscopic findings and clinical course strongly support this diagnosis, though no microscopical proof was obtained.

FROM THE LITERATURE

A review of the literature from 1919 to 1949 reveals reports of 5 other cases, in 2 of which the foreign bodies were inhaled into the bronchial tree.

Case A.—Blake (1943) reported a patient developing symptoms of "acute bronchitis" at the age of 56. Bronchoscopy revealed a carcinoma at the site of a metal crucifix inhaled six years previously. The thorax was explored, but the growth was found to be inoperable, having involved both glands and pericardium. He was treated with radiotherapy and died nine months after exploration with secondaries in the brain. The growth was described as anaplastic.

Case B.—Luckow (1933) reported the case of a man of 58. The metal foreign body was a shell splinter; the carcinoma developing fourteen years after the patient was wounded. At post-mortem the splinter was found in a small-celled carcinoma which was associated with several lung abscesses.

Case C.—Bergeret, Hirschberg, and Millot (1931) reported a case in a man of 45 who had carried a bullet for twenty-three years lying partly in the diaphragm. He had two attacks of pain, one of which was diagnosed as pleurisy, but it was a hæmoptysis which led to the diagnosis of carcinoma twenty-three years after being wounded. At surgical exploration the bullet was found within a malignant mass of varying cell type, some elements being squamous.

Case D.—Several papers (Jackson and Jackson, 1936; Krusen, 1921; Weiss and Krusen 1922) reported the case of a woman of 37 who at the age of 13 months had inhaled the head of a scarf pin, and had had a productive cough thereafter. An exacerbation associated with hæmoptysis following appendicectomy led to the diagnosis. She died of a massive hæmoptysis four months after the appendicectomy. Post-mortem revealed the foreign body in the lower lobe bronchus which was the site of carcinoma with abscess formation. The cell type was squamous.

Case E.—Huguenin, Faunet, and Bourdin (1947) reported a man of 54 who retained a shell splinter for twenty years lying partly extrapleurally and partly within the lung. An epithelioma was diagnosed bronchoscopically a few days before death. The lobe involved, the right upper, was also the site of bronchiectasis. Post-mortem examination revealed secondaries in liver and right suprarenal. The cell type was squamous.

In summarizing these 7 cases (including the 2 cases reported here) it is to be noted that the growths were diagnosed when the foreign bodies had been retained from 6 to 36 years (average 24 years). Hæmoptysis was a clinical feature in 5 cases. In 4 there was associated abscess formation, and in another bronchiectasis. This might suggest that the causal factor in producing carcinoma was prolonged sepsis rather than the presence of the foreign body itself. However, the long latent period before the malignant change occurred hardly supports this view, and in several cases the sequence of events suggests that any sepsis that developed was itself the result of bronchial obstruction by neoplasm.

I am indebted to Professor T. Crawford, of the Pathological Department, St. George's Hospital, for the reproduction of the microscopical slide.

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RECURRENT CARCINOMATA

By MAURICE LEE
SURGEON, UPTON HOSPITAL, SLOUGH

In the *British Medical Journal* within recent months there have been several reports of cases of multiple carcinomata. To quote a few, J. Hosford (1950) describes two female patients with synchronous double primary carcinomata, one with a growth in each breast and the other with a carcinoma in the rectum as well as in one breast.

G. S. Anderson and J. A. Chalmers (1950) in the same number of the *British Medical Journal*, describe a patient with carcinoma of the colon and a papillary carcinoma of the ovary, the tumours being of different types histologically. T. B. Williamson (1950) describes two cases of synchronous carcinomata, one of an adenocarcinoma of the rectum in association with an adenocarcinoma of the prostate and the other of an adenocarcinoma of the rectum and polyhedral cell carcinoma of the breast. Recently at a medical meeting, I demonstrated a specimen of the rectum and colon which showed three primary carcinomata, each unconnected with the other (Pathology Meeting, Medical Society of London). There was only one gland which showed carcinomatous deposits. More recently still, I have seen a woman in Out-patients who showed two primary carcinomata of the breast, one being in the inferomedial quadrant and the other in the axillary tail of the same mamma. As far as could be detected clinically, there were no

secondary deposits in the axillary glands. It has been stated that the frequency of multiple primary carcinomata is between 2 and 5 per cent of all cases of cancer.

Recurrent carcinoma is quite a different matter, and is clinically of equal importance. By recurrent carcinoma I mean one which re-occurs locally following a successful (or apparently successful) radical removal. Recently such a case presented itself, the details of which are given below. The aspect of this subject which I wish to emphasize is that the condition must not be considered in all cases as being inoperable. It is true to say that some cases will be found to be inoperable either on clinical examination or at operation, but this is not always so. All recurrences must start as a localized condition and secondary spread only takes place after an interval of time, which may vary considerably in different patients. For instance, in carcinoma of the breast recurrence may occur as a deposit of carcinomatous tissue in the scar of the previous operation. This local recurrence may not show itself till years after the operation for removal of the breast, and it does not mean inoperability. Wide removal of this deposit, preferably by means of the diathermy current followed by X-ray therapy, may be the end of any further recurrences.

Again, in carcinoma of the colon I have encountered on a few occasions a recurrence of growth in the colostomy, or in the bowel proximal to this, after the neoplasm has been removed by a successful abdomino-perineal operation. Even in cases like these, there may be no signs of distant metastases. Of course in these cases the recurrence of a carcinoma does not necessarily mean recurrence from the growth that has been previously removed. Gabriel, Dukes, and Bussey have shown that more than one growth is found in 4·7 per cent of all cases of primary carcinoma of the large bowel. When another growth is found either at the site of the colostomy, or higher up, it is usually an indication of the development of a new carcinoma in the colon, though in the patient's mind it may mean recurrence of the original growth. There is one important matter which ought to be mentioned at this stage—namely, the pathologist's reports on growths. Very often the report comes back as follows: " Sections of the growth and of the lymph-nodes show no evidence of spread." Even with such a favourable report as this, it is unfortunate that some cases do get recurrence. We as clinicians must remember that spread of growth is not only by the lymphatics but also by other means, as is shown in the case described below. When, therefore, the report comes back showing ' no lymphatic involvement ' it does not mean a guarantee of cure in all cases. Furthermore, we must realize not only that it is impossible for the pathologist to examine the whole field for possible secondaries but that lymphatic spread may be to a distant gland which is left behind after removal of the growth, those removed with the growth being free of any deposits whatsoever. Essentially, however, local recurrence means incomplete excision.

The following case demonstrates these important points.

CASE REPORT

The patient, a woman aged 73, was first seen in January, 1949, complaining of abdominal pain and passing blood per rectum. She had lost 1½ st. in weight. In addition, she had auricular fibrillation. There was nothing to be felt on abdominal examination and sigmoidoscopy up to 20 cm. did not disclose any abnormality. A barium enema showed a suspicious filling defect of the splenic flexure, suggesting the possibility of a carcinoma.

At operation on Jan. 1 a growth of the splenic flexure was found and a colectomy was carried out, an end-to-end anastomosis being performed. An exclusion colostomy (Devine type) was carried out at the same time and this was closed a few weeks after the operation. The patient made an uneventful recovery. The pathologist's report on the specimen was as follows: " Portion of colon 17 cm. long already opened with a fungating carcinoma 5 × 4 cm. half-way along. The gut wall is puckered and kinked. There are some small rather hard glands in the attached mesentery. Sections of the upper and lower ends of bowel show no evidence of spread nor do the lymph-nodes sectioned. The growth is a papilliferous adenocarcinoma, deeply penetrating the bowel wall in some places where it is undergoing mucinous degeneration. It is a very vascular growth and mitoses are moderately frequent, but I can find little evidence of involvement of blood-vessels or lymphatics. Small lymph-node 5 mm. diameter shows areas of hæmorrhage but no growth."

The patient returned to Out-patients again in May, 1950, complaining of diarrhœa for about one month previously. A movable lump (fæcal mass?) could be palpated in the left upper quadrant of her abdomen. There was no liver enlargement and per rectum there was nothing abnormal to be made out. Sigmoidoscopy was normal and a barium enema showed nothing abnormal apart from the irregularity where the previous colostomy had been made. Subsequent examination in the following week still revealed the lump in the upper left quadrant. In spite of the X-ray report, one could not help feeling that there was something abnormal in the peritoneum, and operation was advised.

AT OPERATION.—This was carried out in June, 1950, eighteen months after the previous operation. At operation a growth was found attached to the descending colon just below the splenic flexure. The line of my previous anastomosis could easily be seen. A Paul-Mikulicz resection was performed and the growth was removed with about 6 in. of bowel on either side. No other deposits of growth could be detected elsewhere.

PATHOLOGICAL REPORT (Dr. Cuthbert Dukes).—" The operation specimen consisted of a portion of the descending colon measuring 7 in. in length, together with mesentery and adherent omentum. A linear scar was present in the central region, this being the result of the previous resection and anastomosis. The scar showed no sign of any tumour. The mesentery was normal and no lymphatic glands were found during the dissection. The omentum, however, contained a large mass of growth 1¾ in. in diameter situated close to its point of attachment to the bowel in the region of the anastomosis scar.

" *Histology.*—Section through the linear scar did not show any sign of carcinoma. The mucous membrane in this region was normal in its histology, but the sections showed a great increase in fibrous tissue in the submucosa.

" Sections through the adjacent mass in the omentum showed a large deposit of colloid material with a few scattered mucus-secreting carcinoma cells at the margin of the colloid deposit. The histological picture is that of a deposit of colloid carcinoma of a relatively low grade of malignancy.

"*Conclusion.*—This appears to have been a recurrence from a deposit of carcinoma in the omentum."

Dr. Cuthbert Dukes examined the slides from the first operation specimen and confirmed that this was also a colloid carcinoma; thus showing that the growth in the second operation specimen was of the same type as the growth which was removed at the first operation.

neoplasm. Some carcinomatous cells must have become grafted on to the omentum and these grew, but did not reveal themselves till eighteen months afterwards. The writer is of the opinion that this was definitely a case of a recurrent carcinoma which was spread by contiguity of tissues and that this

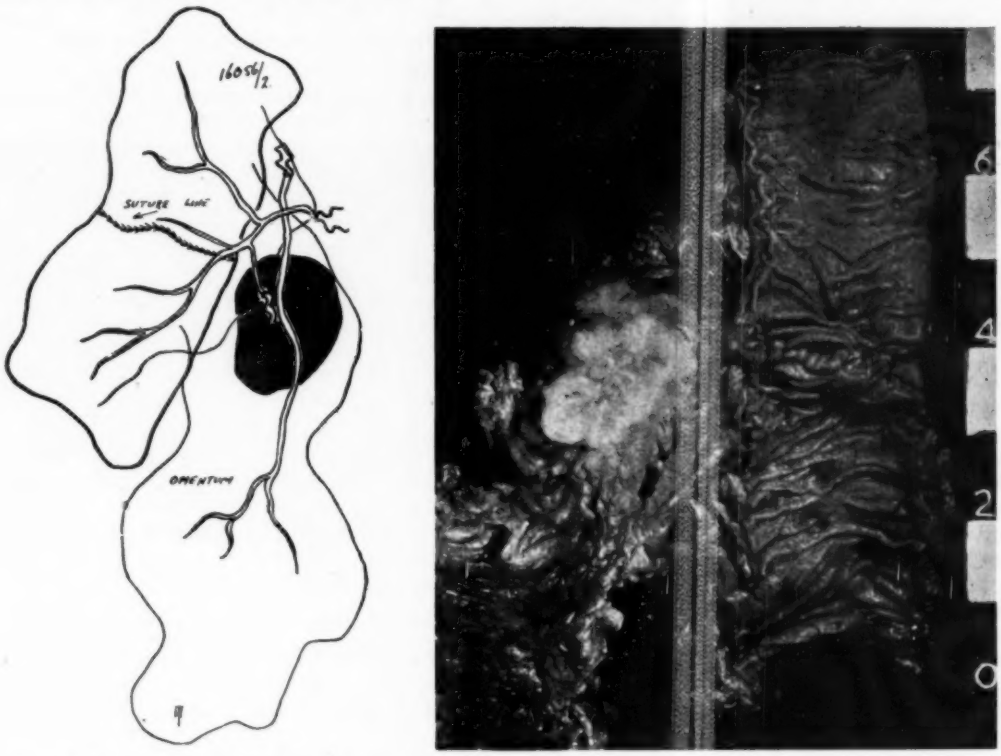

FIG. 764.—Line drawing and photograph of specimen removed at *second* operation. Note the suture line of previous operation (opposite the figure 4 on rule at side of specimen). Adjacent to this a carcinomatous mass is seen in the omentum (black in line drawing). The pathologist reports this as a recurrence from a deposit of carcinoma in the omentum.

SUMMARY AND CONCLUSIONS

From the foregoing one arrives at the following conclusions :—

1. Recurrence of a neoplasm does not necessarily mean inoperability.

2. Should there be a strong suspicion of a recurrence, the surgeon should have no hesitation in advising a second operation for its removal. It is possible in many cases that recurrence is local only and without distal spread, and in these cases there is a good chance of cure. A case of this type is described in detail.

3. Carcinomata spread not only by means of the lymphatics but by continuity and contiguity and also by the blood-stream. The surgeon tries to prevent spread by continuity by removing not only the growth itself, but also a good piece of the surrounding healthy tissue. Spread by contiguity cannot always be detected at the time of operation, and this is demonstrated in the case described above. The growth removed at the second operation was in the omentum, and it would appear that this occurred in the following manner. At some time before the first operation, the omentum must have been stuck to the colon at the site of the may occur more frequently than is usually believed. Fortunately, spread by means of the blood-stream is not so common as by the other means. Cuthbert Dukes believes that hæmic dissemination does occur commonly in carcinoma, but that few of the cells disseminated in this way are able to establish secondary deposits, as the vast majority of the cells which enter the blood-stream die out.

4. It is only by adopting the attitude that there is a chance of cure in operating a second time that many cases can be saved and one should advocate this in suitable cases.

I wish to express my sincere thanks to Dr. Cuthbert Dukes, who kindly undertook to examine the specimen from the second operation, and also to examine the slides from the first operation. His advice was most helpful to me in some details in connexion with this article.

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EXPERIMENTAL SURGERY

EXPERIMENTAL CARDIOVASCULAR SURGERY

By A. T. ANDREASEN and F. WATSON

FROM THE LABORATORIES OF THE ROYAL COLLEGE OF SURGEONS, BUCKSTON BROWNE FARM, DOWNE, KENT

THIS paper records the preliminary results of a series of experiments, the object of which was to define the conditions under which immediate and remote survival of dogs occurs after temporary caval occlusion. The series forms the first part of a research into the possibility of obtaining a 'dry heart' for intracardiac surgery.

THE AZYGOS FACTOR

Whilst nobody would doubt that prevention of the total venous return to the heart will kill a dog in a very short time, it has apparently completely escaped observation that these animals may survive long periods of caval occlusion if the azygos is left open.

The majority of authors employ phrases such as 'occlusion of venous return to the heart' and 'caval occlusion' interchangeably in describing experimental preparations for operations upon the heart. Some state definitely that they tie off the azygos vein, but give no hint that its significance is understood, beyond recognizing that obviously it must be tied to obtain complete restraint of venous return to the heart (Templeton and Gibbon, 1949; Bigelow, Callaghan, and Hopps, 1950). Others make no mention of this vein or how they deal with it (Sewell and Glenn, 1950). Still other workers mention tying it in some of their experiments, but in the analysis of results do not segregate those in which it was tied from those in which it was left open. It is, then, quite evident that none of these workers has any idea of the significance of this 'azygos factor' in the ultimate outcome of their experiments.

Early in the course of this inquiry into the production of a 'dry heart' we found in a few preliminary experiments that dogs survive caval occlusion for more than 10 minutes if the azygos vein is left open. Now O'Shaughnessy (1939) stated that he had never seen even temporary recovery in dogs subjected to caval occlusion lasting 10 minutes. Therefore for various reasons—the vagueness of workers' statements as to whether or not they occlude this vein; because of O'Shaughnessy's statement; because nothing on this problem could be traced in the literature; and because of our preliminary findings—evaluation of this azygos factor in survival after caval occlusion was undertaken.

From the preliminary work the hypothesis " That dogs with the azygos open survive and recover fully from caval occlusion maintained for periods beyond 10 minutes " was proposed.

To establish this, two questions required an answer :—

1. Do all dogs with the azygos open survive periods of longer than 10 minutes' caval occlusion?
2. What length of time of caval occlusion will they survive and recover from?

As a complement to these data it was necessary to know the answer to the following :—

3. Do all dogs die before completion of 10 minutes' caval occlusion if the azygos vein is also closed ?

If they die, then it would appear that this azygos flow is the significant factor in the survival of those in which it was not occluded. Should this be so we must proceed to determine if this flow is sufficient to maintain the brain and heart fully during the periods concerned. This meant answers to the questions :—

4. What is the actual flow through the azygos vein during caval occlusion ?
5. Do all dogs recover fully and behave normally after caval occlusion with the azygos open ?

With this plan before us we had a number of questions to answer by experiment, with as nearly as possible only one variable in each. Together the results should give considerable data, if not result in a solution of the difficulty.

TECHNIQUE AND RESULTS

Standard Technique Employed.—In all these experiments the attitude of the surgeon in the operating theatre has been adopted. Attention was directed deliberately to the 'whole' animal rather than to an isolated organ or organs observed under highly artificial circumstances. All the experiments were therefore operations aiming, as in the human case, at survival with minimal risk and detriment; demanding as the criterion of success restoration to fully normal function.

The details given below were common to all the experiments. A few particular variations are mentioned in the description at the appropriate point.

Common Experimental Data.—

Anæsthesia : Nembutal (40 mg. per kilo body-weight).

Positive pressure oxygen (100 per cent O_2) (Tiegel-Henle machine) for opening thorax and maintaining respiration.

Tracheotomy for delivery of positive pressure oxygen.

Position of dogs : Dorsal, with both hind legs over to left, right foreleg up by head to give room for thoracotomy.

Thoracotomy : Right fourth space. Ribs spread without cutting. Superior vena cava (S.V.C.), azygos, and inferior vena cava (I.V.C.) cleared and a loose ligature passed around each for easy manipulation. Azygos tied or left open as required.

Carotid cannula in left carotid for blood-pressure tracing.

Caval clamps : Pott's ductus clamps. Applied to S.V.C. first, then to I.V.C. ; released in this order. Thoracotomy closed in layers as for survival and recovery. Lungs inflated before closure.

Observation of reflexes, blood-pressure (B.P.), pulse (P), and respiration (R) for at least two hours after closure of chest.

Complete recovery allowed for one dog of each time period, numbers being limited by space available in kennels.

Typical Sequence of Events following Caval Occlusion.—

1. *With Azygos Closed* (*Fig.* 765).—As the S.V.C. clamp is closed there is little or no effect; at closure of the I.V.C. clamp the blood-pressure falls steeply to

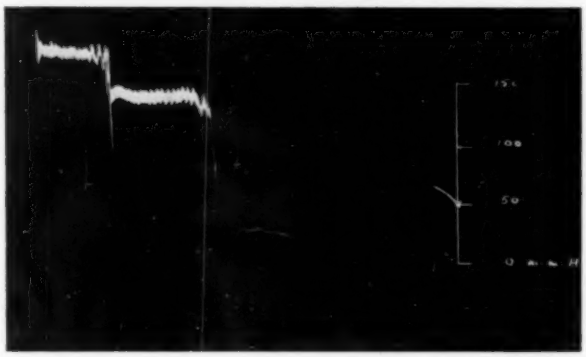

FIG. 765.—Blood-pressure tracing, vena cava and azygos closed. Died in 4 min.

20 mm. Hg or below. Respiration quickens and finally stops within 2 minutes of occlusion. The heart accelerates sharply and then becomes irregular, finally stopping at 4 to 4½ minutes; rarely going on for 6 to 8 minutes, very very feebly.

2. *With Azygos Open* (*Fig.* 766).—A sample record is illustrated in *Fig.* 766 showing recovery and survival after 30 minutes' occlusion of cavæ. Here the first fall is due to the opening of the thorax;

Table I.—SERIES I. (PRELIMINARY.) AZYGOS TIED OFF; ANIMALS ALLOWED TO DIE

EXP. NO.	TIME OF CAVAL OCCLUSION	TIME OF SACRIFICE	TIME OF DEATH	REMARKS
	(Minutes)		(Minutes)	
24	5	—	5	H and R
25	8	—	8	H at 5 R at 4
29	8·4	—	8	H at 8·4 R at 7

H = Heart ceased. R = Respirations ceased.

the second fall is that at the application of the I.V.C. clamp. The blood-pressure after caval clamping is slightly higher than in *Fig.* 765 and remains at 25 to 35 mm. Hg throughout. It will be observed also that the beats of the heart are recorded, although very small in excursion. Meantime the lung blanches, but not to the dead white seen when the azygos is closed. The heart empties and contracts down to a small contracting-relaxing ball; the atria are quite flat. The azygos vein decreases its original diameter by at least 25 per cent. Breathing continues regularly throughout. The heart-rate after a preliminary acceleration to about 160 per min. settles down to a regular 90 per min. The pupils at first contract, but soon come back to about normal aperture. They react to light throughout. Intra-ocular tension is slightly lowered.

After release of the clamps the blood-pressure rises sharply to the original level or higher, settling down to about the pre-clamping level in a few minutes. There is deepening of the respiration and acceleration of the heart for a minute or two, after which normal depth and rate are resumed. Reflexes now proceed to return over the next two to four hours, until five hours later, when the dogs are becoming conscious. This is the normal time of

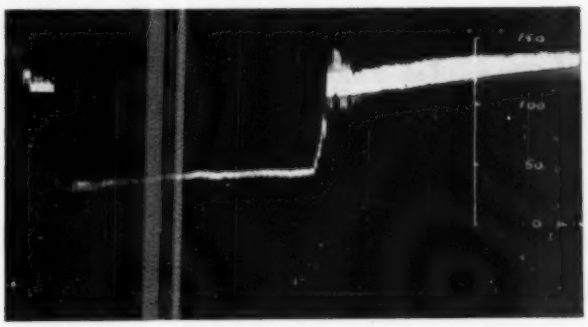

FIG. 766.—Blood-pressure tracing, vena cava clamped, azygos open. Survival.

return to consciousness after nembutal. From then on they behave as normal dogs in every way.

Do all Dogs die before Completion of 10 Minutes' Caval Occlusion if the Azygos Vein is also closed?—In Series I (*Table I*), the results of the preliminary trials with the azygos closed, times of death were from 5 to 8·4 minutes. The respiration ceased always before the heart stopped. Removal of the clamps after the heart had stopped did not

Table II.—SERIES II. AZYGOS CLAMPED AND RELEASED AFTER 5 MINUTES

EXP. NO.	DIED	RECOVERED	RECOVERED WITH C.N.S. SIGNS
44		+	
46		+	
47	+		
49	+		
50	+		
51		+	
52			+
53			+
54		+	
55	+		
56	+		
57			+
58		+	
13	5	5	3*

*Blind and deaf temporarily. Hind leg paralysis.

cause recovery. Arising out of this series is the question: "If the clamps on the cavæ are released at 5 minutes, will the dogs recover"?

Series II (*Table II*) shows the results in 13 dogs in which the clamps were applied for 5 minutes only, the azygos being tied off. In 5 the respiration and heart-beat ceased before the clamps were removed and did not recover when they were; 5 animals

recovered when the clamps were removed and were normal in every way. In this latter group the respiration and heart-beat never completely ceased during the clamping period. In every case a check was made to ensure that the clamps and azygos ligature were in fact efficient; no error was found. Three dogs recovered very slowly over the next 24 hours; they were blind, deaf, and had hind-leg spastic paralysis. Blindness passed off in 24 to 36 hours; deafness improved and disappeared at the same time; the paresis improved but was still evident at three days, when all the animals were sacrificed.

Extending the time of caval clamping to 10 minutes with the azygos closed in Series III shows all dead, without a single recovery possible at the end of that period.

Thus: Ten minutes' total occlusion of venous return to the heart (and, of course, to the brain in this case) is fatal; 5 minutes' occlusion may not be fatal but may cause brain damage.

Table III.—Series IV. Caval Occlusion for 10 Minutes and Over; Azygos Open

Exp. No.	No. of Minutes	Immediate Recovery Normal	Recovery with C.N.S. Signs	Died within 2 hours	Died after 2 hours
12	10	+	—	—	2 hr. +
27	10	+	—	—	4 hr. +
28	10	+	—	—	—
13	15	+	—	—	2 hr. +
14	15	+	—	—	—
15	15	+	—	—	—
16	15	+	—	—	—
17	20	+	—	—	—
31	20	+	—	—	8 hr. +
77	20	+	—	—	—
78	20	+	—	—	—
79	20	+	—	—	—
18	25	+	—	—	—
19	30	+	—	—	3 hr. +
20	30	+	—	—	—
23 (*a*)	30	+	—	—	—
30	30	+	—	—	2 hr. 55 min.
21	35	+	—	—	—
22	35	+	—	—	—
23	40	+	—	—	2 hr. 10 min.

Do all Dogs with the Azygos Open survive Periods of Longer than 10 Minutes' Caval Occlusion?—*Table III* for Series IV summarizes the data of 20 dogs submitted to caval occlusion with the azygos open for periods varying from 10 minutes up to 40 minutes. All 20 made perfect immediate recoveries after release of the caval clamps. Respiration returned to normal; heart-rate, eye reflexes, and blood-pressure all returned to normal in every case. In each dog the chest was satisfactorily closed. All animals lived 2 hours in good condition and without any sign that they might not reach full recovery.

Seven died between 2 hours 10 minutes and 8 hours after closure of the chest. In one of these ventricular fibrillation set in three hours after closing the chest—the cause was not obvious. Three died of what appeared to be primary respiratory failure: their breathing died away quite suddenly. At post-mortem examination the heart and lungs appeared normal. In three others the lungs were found collapsed and solid on both sides; the heart appeared normal. Five out of the seven dogs which died had been maintained on the artificial respiration pump instead of the Tiegel-Henle. We have noticed a number of deaths in another series of dogs so maintained, but with similar operations using the Tiegel-Henle apparatus no deaths occurred.

Counting these 7 deaths as due directly or indirectly to the caval occlusion, 7 died and 13 survived out of 20; that is, the survival rate was nearly twice that of the death-rate. Thus it must be said that all dogs do not survive caval clamping with the azygos open, but that all dogs do make an immediate recovery from the procedure.

Table IV.—Analysis of Cause of Death in Animals in Series IV

Exp. No.	Time of Caval Occlusion	Time of Death	Cause of Death
	(Minutes)	(Hours)	
12	10	2 +	Respiratory failure (O.P.)
27	10	4 +	Total lung collapse (P)
13	15	2 +	Respiratory failure (O.P.)
31	20	8 +	Total lung collapse (P)
19	30	3 +	Acute ventricular fibrillation
30	30	2 hr. 55 min.	Respiratory failure (P)
23	40	2 hr. 10 min.	Total lung collapse

O = Oxygen. P = Respiration pump.

Table IV summarizes the causes of death in these 7 dogs. When this series is set against Series III as a control the results appear to be highly significant and the proposed hypothesis seems to have been upheld as far as immediate recovery is concerned.

What Length of Time of Caval Occlusion will Animals survive and recover from?—Series IV shows that occlusion up to 40 minutes' duration can be survived. Two dogs made uninterrupted recoveries after 35 minutes' occlusion and were alive and normal, about the farm, three months after. One then contracted epidemic diarrhœa and died; the other is still with us, quite well, having grown naturally from a pup to an adult dog.

Series V shows two dogs in which the caval clamps were not removed but the animal allowed to go to extinction of function. Fifty to fifty-four minutes seems to be the limit of life on the azygos flow. Both dogs were dead at about one minute before the time given, failure of the heart being taken as the time limit. The upper limit of the safe period for recovery on this azygos flow would appear to be 40 minutes.

Table V.—Series V. Caval Occlusion maintained Until Death; Azygos Open

Exp. No.	No. of Minutes	Respiration Ceased	Heart Ceased
82	50	48 min.	50 min.
83	54	51 min. 40 sec.	54 min.

What is the Actual Flow through the Azygos Vein during Caval Occlusion?—This was estimated by adapting an electromagnetic flowmeter modified from Kolin (1936) so that blood flowed from the azygos through the magnetic field and on to the heart. Plotted results from a typical set of flow readings are shown in *Fig.* 767.

It is very interesting to note that before the cavæ re clamped the flow in the azygos, in spite of its pparent size at this time, is only in the region of 8 c.c. per minute. Immediately after applying the uperior caval clamp the flow rises to 106 c.c. per inute. As the inferior caval clamp is closed the low drops to between 70 and 80 c.c. per minute. This level is maintained for the remainder of the xperiment—23 minutes in the case illustrated. Throughout the experiment there is actually a steady fall which amounts to 18·5 c.c. in 20 minutes. After release of the caval clamps the azygos flow falls back to the region of 18 c.c. per minute and the blood-pressure resumes normal levels. It should also be noted that the level of the blood-pressure throughout the experiment—25 to 35 mm. Hg—is the usual one for all such experiments.

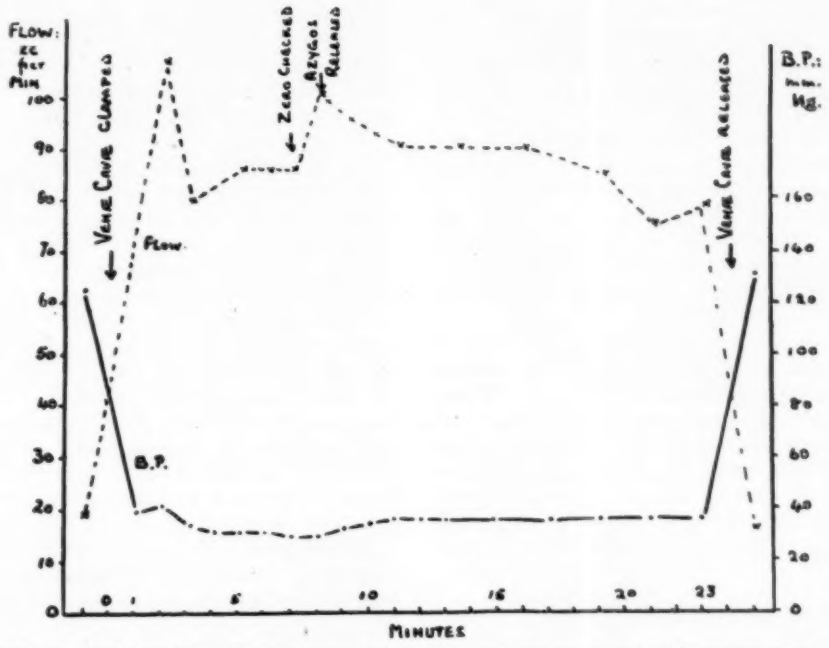

FIG. 767.—Curves of blood-flow through azygos vein during vena cava occlusion, and of blood-pressure corresponding.

Further investigation of the azygos flow suggests that there is actually little or no flow through this vein when the cavæ are open, but there is a tidal wave in it corresponding with the contraction of the atrium. The actual onward movement of blood at the mouth of the azygos may be as little as 4 or 5 c.c. per minute. The tidal movement was visualized by the flowmeter.

The flow which maintains the cerebral and myocardial fields in a healthy state for these long periods is in the region of 90 c.c. per minute. When it is taken into account that there is a steady fall in the flow of about 18 c.c. per 20 minutes it can be readily understood why the limit of safety is reached at about 40 minutes of occlusion, when the effective flow via the azygos would have fallen to approximately 54 c.c. per minute.

Do all Dogs recover fully and behave normally after Caval Occlusion with the Azygos Open ?—None of the dogs in Series IV, even those seven which died some hours later, showed any immediately demonstrable sign of functional detriment. All reflexes were recovered; they came round rapidly from the anæsthetic; proceeded to get up and walk about; recognized people who usually handled them, the same evening, and were generally friendly. They ate, drank, and behaved in every way as normal dogs.

In contrast to these are the three who recovered with signs of cerebral damage after 5 minutes' caval occlusion with the azygos tied off. Their recovery was slow, taking 12 to 18 hours to reach consciousness. They were mentally dull, blind, deaf, and had spastic paresis of the hind limbs. They were savage when handled; drank only if the bowl of water was placed under their noses, and they passed urine where they lay. Evidently they felt the cold very acutely, for they dragged themselves as close to the radiators as the guards would permit.

It would appear that the azygos flow is very close to the minimal safe limit for maintenance of the cerebral and myocardial fields in a state from which full functional recovery may be expected.

CONCLUSION

Maintenance of the small flow through the azygos vein, with the cavæ clamped, is sufficient to maintain the brain and heart without detriment to full functional recovery over periods of at least 35 minutes.

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THE FATE OF EXPERIMENTAL BONE AUTOGRAFTS AND HOMOGRAFTS

By JOHN HUTCHISON

FROM THE ANATOMY DEPARTMENT, UNIVERSITY OF GLASGOW

An account of the first successful bone-graft in animals was published by Merrem in 1810, and the first recorded case of bone-grafting in man was almost a century ago, although probably there had been many previous attempts of which there is no written record. Since then a vast literature has accumulated on the subject, with a wide diversity of opinion regarding operative techniques, the best type of graft, and the tissue reaction in and around the graft. Much of the confusion and contradiction on the subject of bone-grafting is simply due to a lack of precise knowledge of the sequence of histological changes which occurs in the tissues of the graft and in the graft bed. Too often an opinion is based solely on the clinical results or on an isolated histological observation of an experimental graft, ignoring the earlier and later tissue changes.

The present work was designed to provide a record of the histological progress of the various types of bone-graft in different situations. Histological examination of the grafts was made at intervals up to 180 days after the operation. It was hoped that such observations would provide some definite data regarding (*a*) the fate of different types of bone-graft and of the various tissue elements of the graft, and (*b*) the changes in the host tissue of the implantation site.

THE EXPERIMENTS

The experiments were carried out in rabbits (anæsthetized with nembutal and ether) and a note made of any known genetic relationship. There were three groups of experiments: (1) Bone-grafts into muscle; (2) Bone-grafts into bone; (3) Bone-grafts into the anterior chamber of the eye.

In all three groups, each animal had an autograft and a homograft implanted.

1. Transplantation into Muscle.—Two rabbits were used at each operation. A segment of bone about 15 by 5 mm. was removed from the ilium of each rabbit. Adherent muscle was removed but the periosteum was left intact. Each segment of excised bone was divided into four equal parts. Each rabbit had two pieces of bone implanted into the gluteal muscles of one side as autografts, and two pieces of bone inserted into the gluteal muscle of the other side as homografts. Altogether in this group there were 34 muscle autografts and 34 muscle homografts. Each animal was radiographed a few days after operation, at weekly intervals for the first month, and thereafter every month. The grafts were left for varying periods of time and animals were killed 10, 21, 42, 80–120, and 180 days after operation. Each bone-graft was radiographed on removal and after decalcification, serial sections were cut 10 μ, thick and stained with hæmalum and eosin for microscopical examination.

2. Transplantation into Bone.—Two animals were again used at each operation. A disk of bone about 7 mm. in diameter was removed from the right and left ilium of each rabbit. The bone disk from the right ilium was fitted into the disk cavity in the left ilium of the same animal. The disk from the left ilium of one rabbit was fitted into the corresponding cavity on the right ilium of another rabbit. Thus each rabbit had an autograft in the left ilium and a homograft in the right ilium. Sixty bone-grafts into bone were performed and subsequent procedure carried out as described for the first group of experiments.

3. Transplantation into the Anterior Chamber of the Eye.—Small pieces of bone were removed from the crest of the ilium of two rabbits and divided into fragments about 2 mm. in diameter. Each animal had autografts inserted into the anterior chamber of one eye and homografts into the anterior chamber of the other eye. This was done by puncturing the cornea obliquely just in front of the limbus and inserting two or three small fragments of bone through this aperture. Although aqueous humor escaped freely through the incision, the normal eye tension was restored within twenty-four hours. Fifty-six transplantations into the anterior chamber were performed and subsequently removed, radiographed, and prepared for histological examination at the stated intervals. The grafts were from time to time examined in the anterior chamber by slit-lamp illumination, but these observations were of little value.

Table of Experiments

Site of Implantation	Duration of Implantation in Days				
	10	21	42	80–120	180
Muscle:					
Autogenous	8	8	6	6	6
Homogenous	8	8	6	6	6
Bone:					
Autogenous	6	6	6	6	6
Homogenous	6	6	6	6	6
Anterior chamber of eye:					
Autogenous	7	7	6	4	4
Homogenous	7	7	6	4	4

DESCRIPTION

Bone Autografts into Muscle.—

Radiography.—The grafts were mainly of cancellous bone. There is no change in the radiological appearance at 10 days, but at 21 days there is some decrease in the density of the shadow and by 42 days the two bone fragments have united. The graft now looks like a small bone with central cancellous tissue surrounded by dense cortical bone with a regular outline.

Histology.—During the first 21 days, the grafts appear to become devitalized. The lacunæ of the matrix are empty except at the periphery of the bony

trabeculæ (*Fig.* 768), where the younger osteocytes have survived. The soft-tissue elements of the grafts—periosteum, lining of Haversian canals, and endosteum (mostly endosteum, as the grafts are cancellous bone)—show active cellular proliferation at 10 days. The flattened endosteal cells, particularly those adjacent to the bone, enlarge and become oval-shaped with well-staining round nuclei. They are, in fact, differentiating into osteoblasts. This proliferation and differentiation of endosteal cells is well marked in the younger grafts (10, 21, 42 days). The zone of cellular activity surrounds the bony trabeculæ, forming either a single layer of osteoblastic cells or elsewhere multiple layers (*Figs.* 769, 770). Here and there, these clusters of osteoblasts appear to be pushing into the bony matrix of the trabeculæ and the histological picture suggests that they are colonizing the matrix of the graft. Certainly from 21 days onwards the autografts gradually regain their cell population, which approximates to normal by 42 days (*Fig.* 771). By this time there is much less endosteal activity, and at 80 days and thereafter it has ceased except in occasional areas. In the case of the cortical bone included in some of the grafts, the acellularity is more complete in the early stages and the restoration of the normal cell population slower. By 80 days there are still a few empty centrally placed lacunæ. Many of the grafts have islets of cartilage

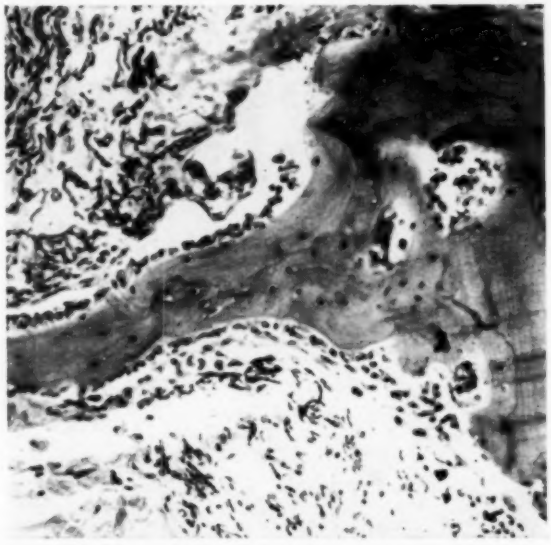

FIG. 768.—Autograft into muscle—10 days. The matrix is devoid of cells except at the periphery of the trabeculæ. The surviving endosteal cells show commencing proliferation. (× 133.)

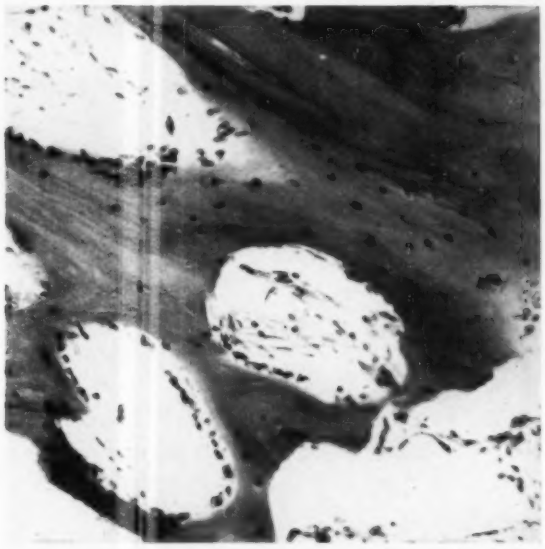

FIG. 769.—Autograft into muscle—21 days. The phenomenon of migration of osteoblasts from the endosteal proliferation is seen. Many areas are still devoid of nuclei but repopulation is proceeding. (× 133.)

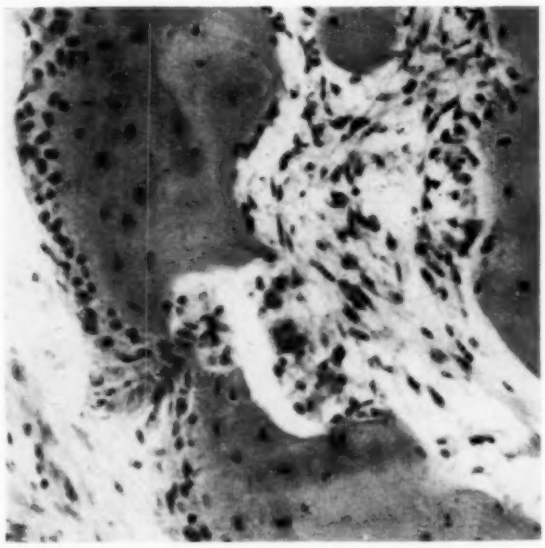

FIG. 770.—Autograft into muscle—42 days. Numerous osteocytes in the substance of the matrix with osteoblasts at the periphery. In places these cells form clusters. (× 166.)

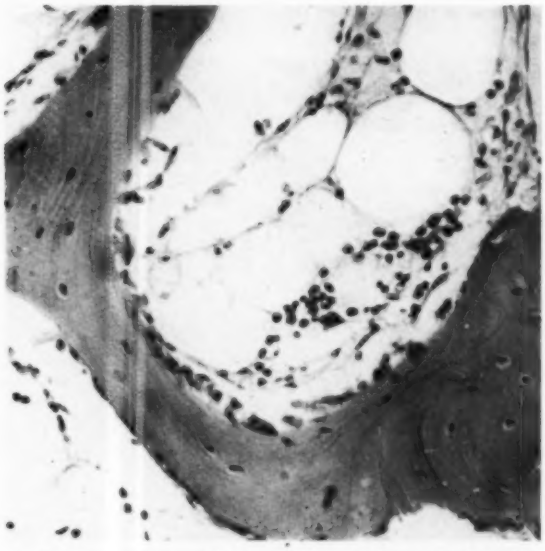

FIG. 771.—Autograft into muscle—42 days. The smaller trabeculæ have a normal appearance and the surrounding endosteal cells are reduced to a regular layer. (× 166.)

cells, which are normally present in the rabbit ilium. The cartilage cells, unlike the osteocytes, do not degenerate, but survive throughout (*Fig.* 772), and characteristically induce the formation of chondro-osseous tissue from adjacent soft tissues. The marrow survives in an active condition throughout (*Figs.* 768, 771).

FIG. 772.—Autograft into muscle—21 days. Surviving cartilage with the formation of chondro-osseous tissue in its immediate vicinity. (× 166.)

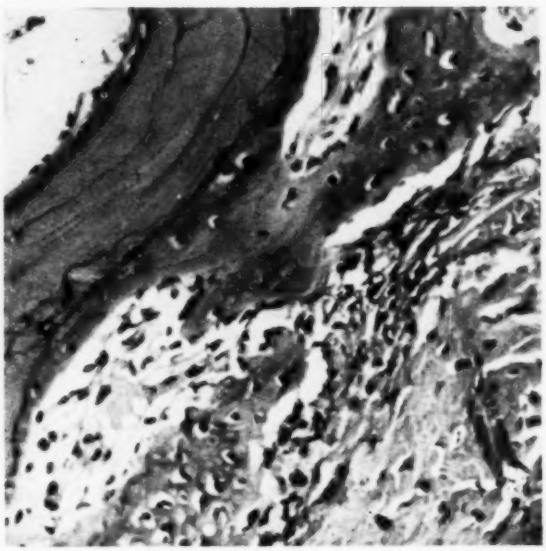

FIG. 773.—Autograft into muscle—10 days. Host connective tissue differentiating into osteoblasts with new-bone formation closely apposed to the transplant. (× 166.)

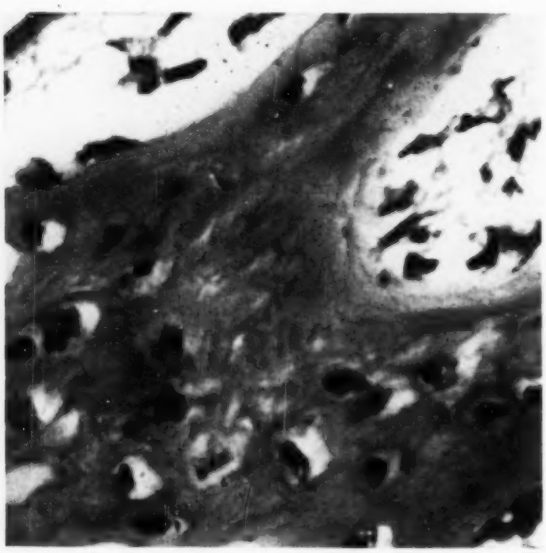

FIG. 774.—Autograft into muscle—10 days. New bone formed by the host tissues. (× 500.)

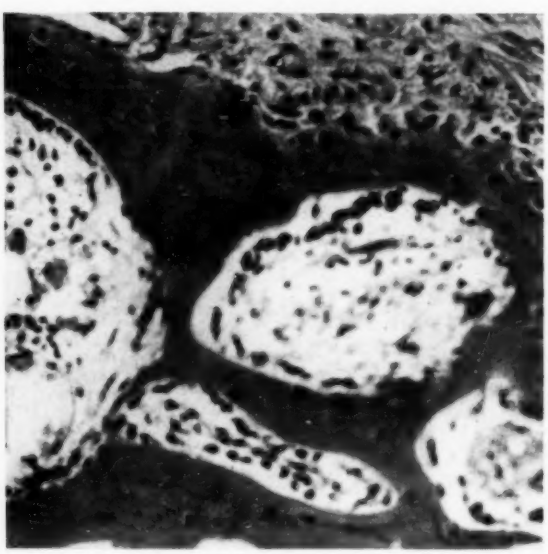

FIG. 775.—Autograft into muscle—180 days. The bony matrix is populated by mature osteocytes. The host contribution cannot be distinguished from the original transplant. (× 266.)

At the end of 10 days the host tissue of the implantation site has formed a capsule of cellular connective tissue round the graft. The host cells adjacent to the graft have the form and appearance of osteoblasts (*Figs.* 773, 774), and some of them are making their way into graft bony matrix, while others are forming trabeculæ of new bone which add to and surround the graft tissue. After 42 days the host tissue is less active-looking, and later forms a capsule consisting of an outer layer of fibrous tissue and an inner osteogenetic layer—in fact, a periosteum. In the early stages there is no difficulty in distinguishing between the new bone formed from host tissue and the recovering donor bone. From 80 to 180 days the graft consists of the original donor tissue plus the osseous contribution from the host tissue, and it is impossible to distinguish the two (*Fig.* 775). There is no evidence of any considerable increase in the size of the graft by the growth of donor bone itself—that is, from intrinsic ossification. Some sections certainly show the peripheral osteoblasts laying down layers of new bone, but this is not a marked feature except in cortical bone-grafts where

there is appositional new-bone formation. In young animals the autografts at 42 days have the histological characteristics of young active bone (*Fig.* 776).

Bone Homografts into Muscle.—

Radiography.—There is no evidence of decalcification in the early stages, and after 42 days the radiographs suggest an increase in the density of the bone.

Histology.—After 10 days, although the bone matrix is still well stained, all the lacunæ are empty and there are no osteocytes with the exception of the odd one situated peripherally (*Fig.* 777). The matrix later becomes opaque, and finally the appearance is that of a typical sequestrum. After 180 days the homograft is represented by small sequestra with

FIG. 776.—Autograft into muscle—42 days. · Young active bone tissue—transplantation between young animals. (× 133.)

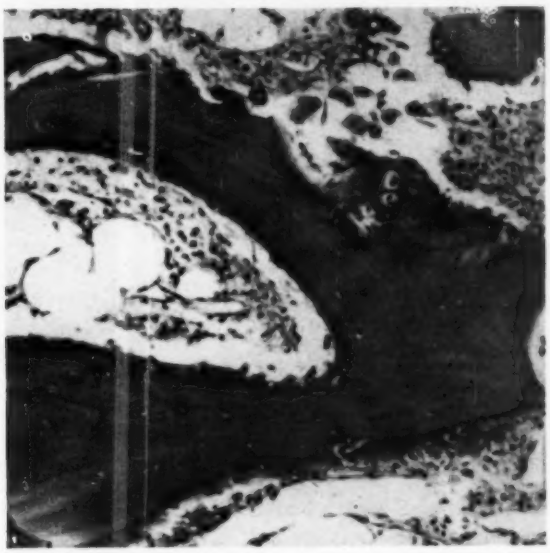

FIG. 777.—Homograft into muscle—10 days. Dead bone tissue with empty lacunæ; the dense outline is due to bony lysis. (× 133.)

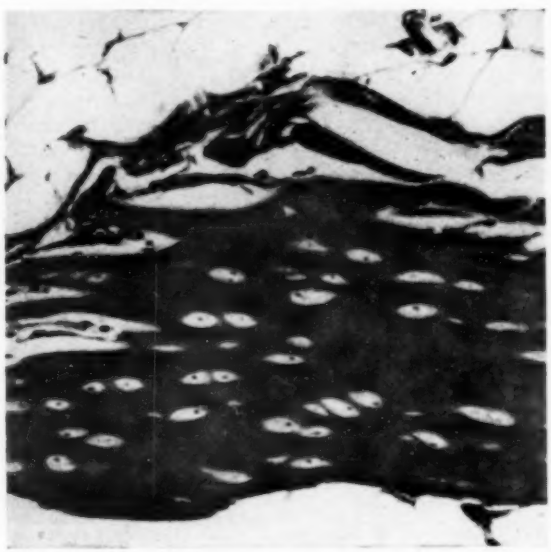

FIG. 778.—Homograft into muscle—180 days. Sequestrum-like remains. The lacunæ are empty and the necrotic bone tissue is isolated from the surrounding tissues. (× 500.)

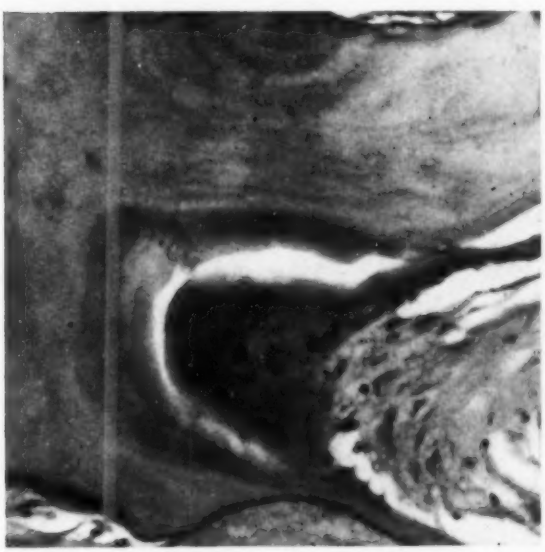

FIG. 779.—Homograft into muscle—42 days. Showing the transition from connective-tissue cells into osteoblasts laying down new bone and the characteristic wave-like regression of the dissolving edge of the dead matrix. (× 133.)

The two fragments do not unite. In fact, after 42 days, all the homografts diminish in size and become broken up into additional fragments, each with an increased density and irregular outline. There is no differentiation into cancellous and cortical bone in the later stages, and in two of the 180 days' specimens there was no bone shadow.

frayed outlines (*Fig.* 778), and in two specimens the only remains were a few crystalline spicules enclosed by a capsule of fibrous tissue. The soft-tissue elements (mainly endosteum) show no proliferation or osteoblastic differentiation, and in contrast to the marginal rows of osteoblasts enclosing the trabeculæ of the autograft bone, the homografts have a dense

border due probably to bone lysis, and no surrounding cells (*Fig.* 777). As in the autografts, there is at an early stage a capsule of host connective tissue with, up to 42 days, some lymphocytic infiltration. From 10 to 42 days osteoblasts, differentiated from the proliferating connective tissue cells of the host, lay down trabeculæ of new bone close to the dead donor bone. This new bone is replacing the gradually receding and dissolving edge of the homograft—the so-called 'creeping substitution' (*Fig.* 779). At 80 days and later this new host bone is dead (*Fig.* 780) like that of the homograft. Islets of cartilage included in the homografts survive in a healthy condition up to 80 days (*Fig.* 781). In the later stages the cartilage cells die in most specimens (*Fig.* 782), while in some there are islets of healthy cartilage even at 180 days.

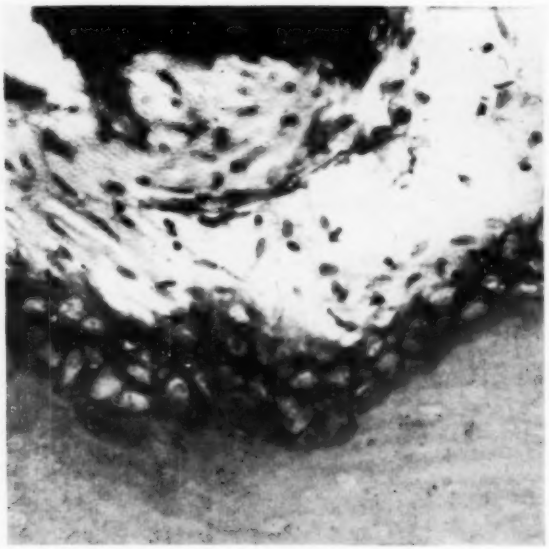

FIG. 780.—Homograft into muscle—80 days. The peripheral layer of new bone laid down by the host is quite devitalized. (× 333.)

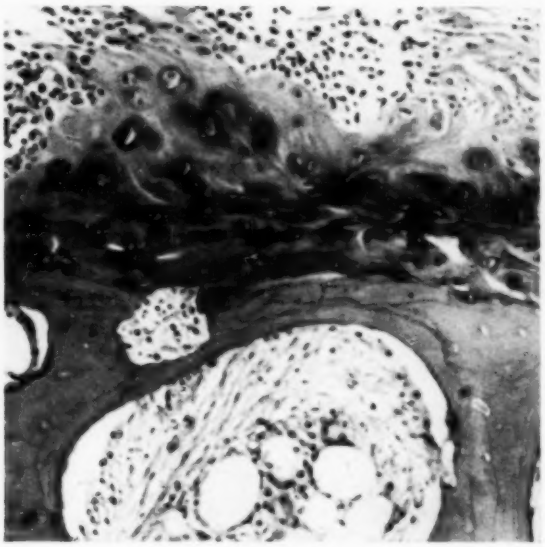

FIG. 781.—Homograft into muscle—21 days. The bone tissue is devitalized but cartilage has survived. (× 133.)

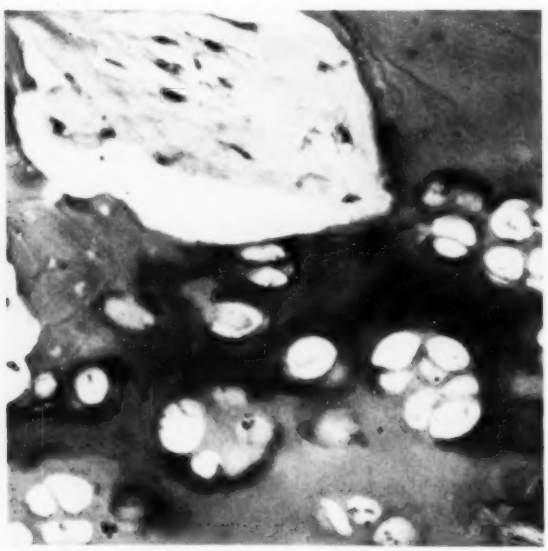

FIG. 782.—Homograft into muscle—180 days. Bone and cartilage tissue are both quite devitalized. (× 466).

FIG. 783.—Autograft into bone—10 days. There is some cell survival but the more centrally placed osteocytes have disappeared. Endosteal proliferation is seen. (× 166.)

Bone Autografts into Bone.—

Radiography.—There is no change in the radiological appearance of the graft disks of bone during the first 21 days. At 42 days it is difficult to define the outline of the graft, and after six months it cannot be identified.

Histology.—At 10 days the bone-graft is separated from the host bone by a connective-tissue capsule. This later becomes ossified, and at 80 days it is difficult to identify graft tissue histologically. The course of events is more or less the same as when the bone is transplanted into muscle. There is an

nitial period of devitalization apparent at 10 and 21 lays, and longer in the case of the denser cortical one when the lacunæ, particularly the centrally placed ones, are empty and there is marked acellularity of the grafted bone. There is some proliferation and osteoblastic differentiation of graft

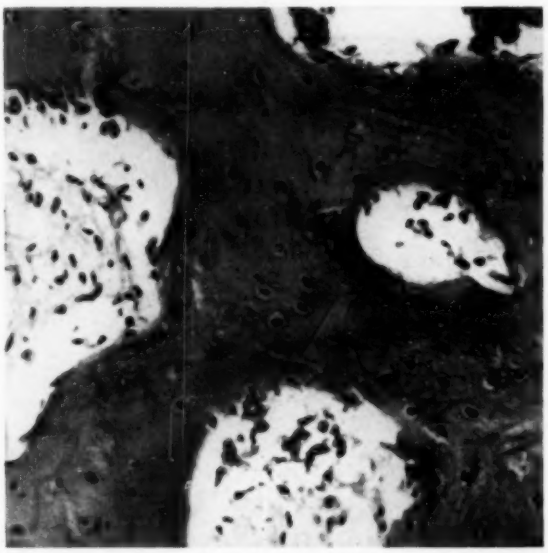

FIG. 784.—Autograft into bone—42 days. Cancellous transplant with abundant young osteocytes and proliferation of the endosteal tissues. (× 166.)

connective tissue, again mostly endosteum, and these osteoblasts are arranged along the periphery of the bony trabeculæ (*Fig.* 783). At 42 days the grafts have regained their normal complement of cells (*Fig.* 784), colonized presumably from the newly differentiated osteoblasts. These osteoblasts may also lay down new bone, particularly along the periphery of the denser cortical bone. The osteoblasts formed from the host connective tissue also lay down trabeculæ of new bone, and this finally effects a complete union between host and graft.

Bone Homografts into Bone.—

Radiography.—There is no apparent increase in density and the graft disks can be recognized up to 80 days, cf. autografts.

Histology.—At 21 days the bone-graft is completely dead. There is a poorly staining matrix with empty lacunæ and the characteristic dense border already noted in the homografts in muscle. There is no differentiation or invasion by osteoblasts. At this stage the graft has its capsule of host connective tissue. Some of the host cells have formed osteoblasts and are laying down trabeculæ of new bone (*Fig.* 785). At 80 days and thereafter it is no longer possible to identify the dead bone of the graft, host bone, or the new bone trabeculæ formed by host connective tissue. The new bone has apparently not only effected a union between graft and host bone, but very largely replaced the dead homograft. *Fig.* 786 shows a homograft of young bone implanted into a young animal which included some cartilage cells, and in this case there was a vigorous formation of chondro-osseous tissue by the host.

Intra-ocular Bone Autografts.—

Radiography.—At 21 days there is some decrease in bone density, but by 80 days the fragments have united and the graft has the appearance of a small bone with a cancellous centre and a denser cortical layer.

FIG. 785.—Autograft into bone—21 days. New bone formed by the host tissues arranged in well-formed trabeculæ and permeating the dead transplant. (× 166.)

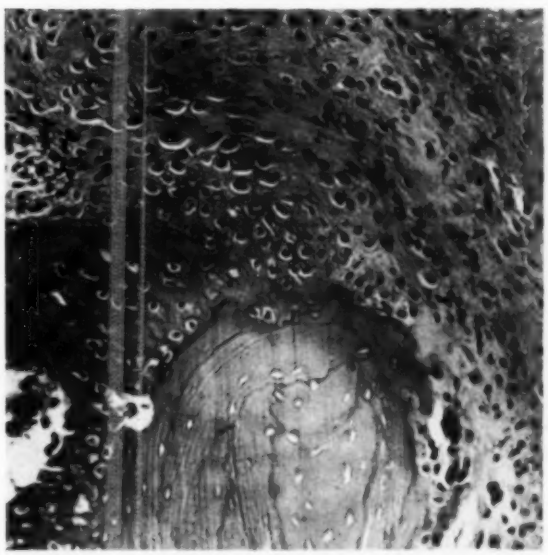

FIG. 786.—Homograft into bone—21 days. Active chondro-osseous tissue surrounding the dead transplant—a young host. (× 166.)

Histology.—As there is a minimum host tissue reaction in intra-ocular grafting, this method provides an excellent opportunity to study the changes in the grafted bone itself. The changes are similar to those already described in autografts implanted in muscle or bone (*Fig.* 787). There is, however, this difference. The graft is invariably attached by one surface to the surrounding host tissue, but the other surface may lie free in the aqueous humor (*Fig.* 788).

There is relatively little host tissue reaction, and consequently fewer host cells differentiate into osteoblasts. Where the graft surface lies free in the aqueous humor it is also surrounded by newly formed osteoblasts. These take part in the replacement of the effete osteocytes of the graft and, in older specimens (80 to 180 days), the host tissue forms a cancellous or cortical bone formation, and the frag ments remain separate.

Histology.—Here, as elsewhere, the homograf dies (*Fig.* 790). There is a more marked host tissu reaction than with the autograft, and accordingly greater formation of osteoblasts from host cells. A 21 days these host osteoblasts have formed trabecula

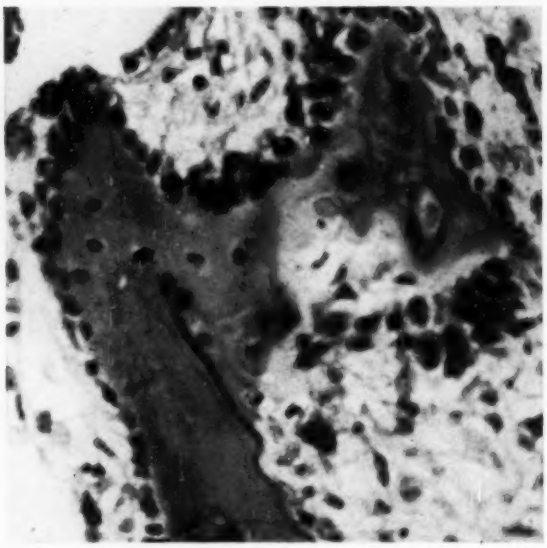

FIG. 787.—Autograft into anterior chamber—10 days. Some peripheral osteocytes have survived and there is a marked endosteal osteoblastic proliferation. (× 200.)

FIG. 788.—Autograft into anterior chamber—42 days. One surface lies free in the aqueous humor. Migration of osteoblasts is seen on all sides. (× 166.)

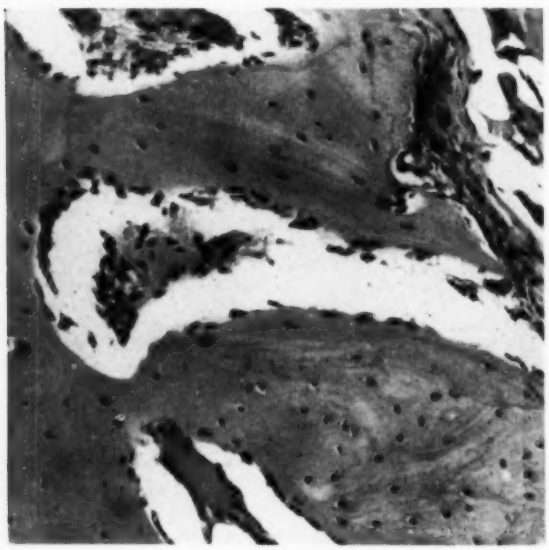

FIG. 789.—Autograft into anterior chamber—180 days. Bone tissue of normal mature appearance. (× 133.)

periosteum on the attached surface of the graft with its layer of young osteoblasts and outer fibrous part (*Fig.* 789). There is no evidence of the new-bone formation by the host tissue which is present in the bone autografts into muscle and bone.

Intra-ocular Bone Homografts.—

Radiography.—The bone shadow becomes denser in the older specimens, but there is no evidence of of new bone. At 42 days this new bone has died and added to the size of the total sequestrum. Where cartilage cells are present some may survive for long periods, but ultimately they undergo necrosis. All the homografts left for 120 to 180 days were recovered (*Fig.* 791).

DISCUSSION

In spite of the very considerable volume of work on bone-grafting, there is even to-day no definite knowledge of what happens histologically to bone autografts and homografts. Reynolds and Oliver (1949), in an experimental study of bone-grafts in dogs, are in complete agreement with the previous observations of Barth (1893) that all the elements of both autografts and homografts of bone die and are replaced by host tissue. They state that the replacement of autografts and homografts is accomplished by appositional new-bone growth from the host tissues. It is significant that they make no statement as to the age of the grafts when examined histologically. In this series the appearance of the autografts at 10 and 21 days, with their empty lacunæ and lack of osteocytes, would on superficial examination certainly suggest that the graft has died. However, even in the early stages, it is quite clear that the soft-tissue elements of the graft not only survive but are actively proliferating and forming osteoblasts.

Every tissue graft has an initial test period before it 'takes', that is, before it becomes vascularized. Because of the hard ground substance, this testing time is more critical in the case of bone-grafts, particularly with the denser cortical bone. Thus

the remote bone cells enclosed in the hard matrix die from lack of adequate nutrition. After successful vascularization, the autograft survives, necrotic cells are replaced, and, by 42 days and later, the appearance is that of active living bone.

The more rapid and certain revival of smaller grafts—of cancellous as opposed to cortical bone, and of young bone rather than old bone—is due to the relative facility of vascularization and the greater number of surviving bone-cells per unit area in the early stages. Lacroix (1951), quoting a number of publications, including recent work by Engstrom (1937), Levander (1938), Albert (1938), and Abbott, Schottstaedt, Saunders, and Bost (1947), states that there is no doubt that autografts of fresh bone placed under the skin or into muscle are invaded by host connective tissue and finally absorbed, leaving close to the site of the graft some trabeculæ of new bone. He himself planted autografts under the renal capsule, and his Figure 81 is a low-power photomicrograph of the graft site 45 days after operation, with the explanation that all the autograft bone has been absorbed and there remain only plaques of new bone formed from host tissue. He, however, admits that there is survival, proliferation, and osteoblastic formation from periosteum, Haversian canals, and endosteum. The conclusion that the autografts die and become absorbed is quite contrary to the findings in these experiments. It is known that in plastic procedures designed to replace the mandible, autografts occasionally are absorbed, but this is the exception rather than a normal expectation. Moreover it is very difficult to understand why dead autografts should be so rapidly absorbed (within 45 days) and the dead homografts still present at 180 days.

In the specimens examined here, there was no difficulty in following the changing condition of the autografts, particularly in the intra-ocular grafts, where there was no new-bone formation by host tissue.

Albee (1944) insists that autografts not only live but grow like " grafted twigs ". The analogy with plant grafting is unfortunate as grafted twigs or scions retain their individuality as regards growth pattern and other qualities. If the autograft is into bone then after 42 days it was impossible in the rabbit to identify graft from host bone, and thus it was not possible to make any definite statement regarding the continued growth of the graft. When implanted into muscle or into the eye there was no evidence of any considerable increase in size or growth of the graft after 180 days, in spite of some new-bone formation by host tissues. Obviously transplantation does not release the growth potential of the grafted tissue, even in young grafts, and either the previously determined inhibition is still inherent in the graft or is imposed on the graft by the tissue hierarchy of its new milieu.

The many claims for the successful use of bone homografts recently assessed by Ghormley (1942) are based on functional results and there is no authentic record of the histological survival of the bone homograft. Homografts of other tissues and organs, for example skin, usually ' take ', that is, become vascularized, and may survive for varying periods up to several weeks, but even the soft tissues of the bone homograft never ' take ' and the initial devitalization progresses to the complete death of all the elements of the graft. It is not relevant here to discuss the various theories which have been advanced to account for the intolerance to homograft tissue, but a host reaction has obviously developed before vascularization of the graft could be accomplished. The ultimate fate of bone homografts varies in the different implantation sites. In bone the homograft tissue was finally replaced by host bone. Thus clinically it not only serves as a mechanical scaffolding but promotes new-bone formation. In muscle the bone homograft may persist as a sequestrum, at any rate up to 180 days, or it may be absorbed. It is

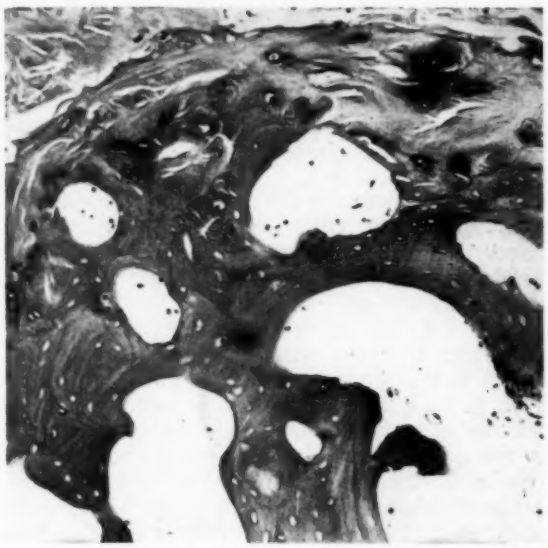

FIG. 790.—Homograft into anterior chamber - 42 days. Dead bone tissue with sharp outline and no endosteal reaction. (× 133.)

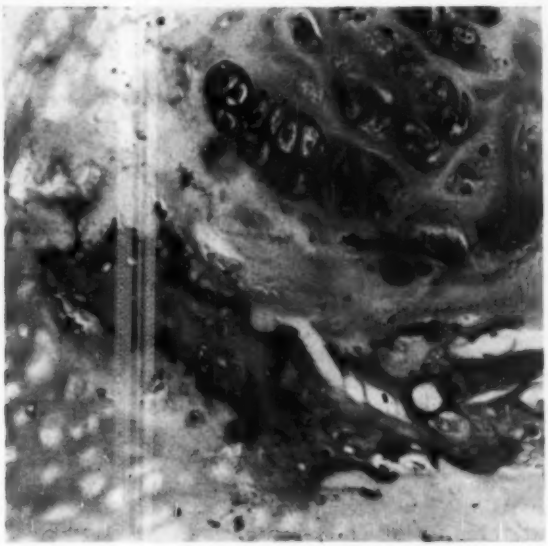

FIG. 791.—Homograft into anterior chamber—180 days. Bone tissue, cartilage, and new bone, formed by the host, have all undergone necrosis. (× 133.)

possible that all the homograft sequestra in the muscle will in time disappear. The bone homografts left in the eye for 180 days were all recovered as sequestra. Probably the diminished tissue reaction in this region precludes absorption.

Considering the well-known survival capacity of hyaline cartilage as a homograft, it was surprising to find that the islets of epiphysial cartilage included in many of the homografts ultimately die. This cartilage, destined to become bone, in this respect displays a curiously proleptic characteristic.

Cell Repopulation.—The repopulation of the acellular matrix of the bone autografts by osteocytes is almost complete by 42 days and, in the 80 days' specimens, even cortical bone has its normal complement of cells. In all the bone autografts up to 42 days proliferation and metaplasia of soft-tissue cells is a constant feature. These newly differentiated osteoblasts are often massed along the periphery of the bone trabeculæ and the histological picture irresistibly suggests the migration of bone-cells from the periphery into the more central lacunæ. By 80 days, when the lacunæ are occupied by osteocytes, this endosteal activity has subsided. There is nothing new in the suggestion of cellular repopulation by migration of cells from the periphery. Such a process has been described by Fell (1932, 1933) and Gaillard (1942) in connexion with the *in vitro* growth of bone where cells have been observed migrating from Haversian canals, intertrabecular spaces and subperiosteal regions. Osteoblasts differentiated from host tissue make a minor contribution to the repopulation of the bone autografts. In the grafts of cancellous bone, there is no new-bone formation by these cell colonies liberated from the endosteum, although they form new bone in cortical autografts. In the absence of any marked osteoclastic activity, it is recognized that it is difficult to explain how these cells can penetrate the calcified matrix unless their progress is preceded by a softening process. A ready alternative explanation is that the osteocytes do not die, but undergo necrobiosis analogous to the chromatolysis of damaged nerve-cells, and that their histological reappearance is overt evidence of their recovery. At one stage, however, the lacunæ are completely empty with no evidence whatsoever of devitalized cells. Moreover, the autogenous transplants do not regain normal cell content until about 80 days—too long to represent a period of recovery of necrobiotic cells. In the intra-ocular grafts, where there is a minimum of host reaction, there are sections which show a regular procession of osteoblasts from an endosteal space into the dense matrix, and it is difficult not to be convinced that this is a cell migration. The colonies of osteoblasts produced from the soft tissues of the graft have purpose and function. This is not the production of new bone to replace the donor bone but the replacement of the grafted osteocytes unable to survive the initial testing-time.

Osteogenesis.—While the fragments of the bone autografts finally join together to form one bony mass, there was no continued growth and increase in size of the graft by the formation of the new bone. The grafts consisted mostly of trabeculæ of cancellous bone and the newly formed osteoblasts were utilized to replace the degenerated cells of the graft rather than to form new bone. Once established in lacunæ, these osteocytes would doubtless contribute to normal maintenance. In the case of cortical bone there was some appositional new-bone formation in the subperiosteal region. Both autograft and homograft bone induced osteogenesis in the connective tissue of the host. This osteogenesis was active from 10 to 42 days, but thereafter there did not appear to be further new-bone formation. When bone autografts are implanted into muscle, by 42 days the new bone formed by the host tissue is added to the graft and the surrounding connective tissue forms an including periosteum. When the autograft is into bone, graft and host bone are indistinguishable after 42 days. In the intra-ocular autografts there is a minimum host tissue reaction, and little or no new-bone formation. In the bone homografts the new bone formed by the host tissue in the early stages—up to 42 days—replaces the retreating and dissolving edge of the dead graft, and when the graft is embedded in bone it appears to be finally completely replaced by living host bone. In the other implantation sites, the new bone formed from the host tissues dies after 42 days, is added to the sequestrum of the graft, and, if embedded in muscle, both the dead graft and the dead host bone will possibly be finally absorbed, although with two exceptions they still persist after 180 days.

Given a suitable medium—for example, young connective tissue—bone appears to be able to induce osteogenesis. No other form of tissue graft possesses this quite unique property. Neither skin, cartilage, or nerve, nor any of the organs can, when grafted, induce the host tissues to metaplase into the corresponding graft tissue. Whatever the causal factor, it is not individually specific, as homografts can also promote host osteogenesis in the early stages. Why should the bone induced by the homograft but formed from host tissue also die? Does it share the specificity of the homograft? It seems unlikely. When the graft is embedded in bone, the new host bone survives and ultimately replaces the graft. It is possible that, when embedded in soft tissues, the marked proliferation of host fibrous tissue succeeds in strangling the new bone, or it may be that the response of host bone (e.g., where the graft is implanted in bone) is a normal reparative process, while elsewhere the osteogenic stimulus vanishes with the death of the transplant before the new bone acquires its morphological independence.

The cause of the occurrence of osteogenesis in the host tissue is part of the general problem of bone formation, common alike to bone development, growth and heterotopic ossification. From graft experiments it is apparent that bone possesses some factor or factors which, under certain circumstances, can induce bone formation in other tissues. There have been many theories advanced to account for osteogenesis in grafting and elsewhere. Lexer (1924) suggested that the osteoblasts migrate from the transplant, seed the young connective tissue of the graft bed, and communicate their properties to the host tissue. But it has been shown that bone previously fixed in alcohol still possesses this osteogenic ability (Nageotte, 1920; Polettini, 1922). Thus living bone-cells are not the essential elements. Blum (1944) claimed to be able to produce heterotopic bone by intramuscular injections of phosphatase, but

these results have not been confirmed (Slessor and Wyburn, 1948). Levander (1938) and Annersten (1940), working independently, have claimed to be able to produce bone formation by injections of a specific osteogenic substance or substances, obtained as extracts from bone, and further work by Lacroix from 1945 to 1951 has been responsible for the now generally accepted theory of ' osteogenin ', although much more information is required about the chemical composition of this extract. The more active and prolific osteogenesis following transplantation of young cartilaginous bone, suggests a more potent quantitative and qualitative osteogenic capacity.

CONCLUSIONS

1. Autografts of bone, after an initial period of devitalization, recover and survive as active living bone.

2. Homografts of bone die and if implanted into muscle the sequestrum may finally be absorbed. If implanted into bone, they are replaced by new host bone.

3. The mature osteocytes of autografts degenerate in the early stages and are replaced by osteoblasts formed by metaplasia of the cells of the soft-tissue elements of the donor bone.

4. Both autografts and homografts induce new-bone formation by the tissues of the host. In the case of homografts implanted into muscle or into the anterior chamber of the eye, this host bone dies and is added to the graft sequestrum.

I wish to express my thanks to Mr. George Marshall for his technical assistance.

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SHORT NOTES OF RARE OR OBSCURE CASES

MASSIVE MALIGNANT MELANOMA OF THE PENIS

OCCURRING IN A MALAY

BY D. I. ROBERTS, LIEUTENANT, R.A.M.C.

DESPITE the continued confusion as to the status of malignant melanotic tumours, all authors are agreed that malignant melanoma of the penis is a rarity. Since 1871, only 12 cases have been reported in the literature (*Table I*). Wheelock and Clark (1943) found 2 malignant melanomata of the penis in a series of 59,793 surgical and 2822 autopsy specimens. In the same group were 31 squamous-cell carcinomata.

The following is probably the thirteenth case of malignant melanoma of the penis to be described.

CASE REPORT

HISTORY.—A male Malay, aged 62 years, was admitted to hospital on Feb. 5, 1951, complaining of a penile growth of four months' duration.

Until eight months previously he had been fit. He then started to pass blood in his urine. This continued for four months, when two white pustules appeared on the glans near the corona. These coalesced to form an ulcer ' like a syphilitic sore ' and he began to pass his urine through the ulcer base instead of through the external meatus.

From this time onwards the ulcer rapidly developed into a large growth. During the last four months there had been occasional episodes of hæmaturia, but the urine was normal in colour in the intervening periods, and there had been no frequency.

The patient said that he had lost a lot of weight since the illness started. He denied ever having had venereal disease, and said that there was no family history of a similar penile growth.

ON EXAMINATION.—A thin, but fit, elderly man. A large, roughly spherical growth, varying between 9 and 11 cm. in diameter, replaced the glans and distal half of the shaft of the penis. The growth was grey black in colour, foul-smelling, fungating, and friable, but did not bleed readily when handled with a swab. The tumour surface was replaced in parts by areas of yellow slough. The external meatus was unidentifiable and it was impossible to tell whether circumcision had been carried out, although this was considered unlikely. (*Fig.* 792.)

Hard, non-tender, non-fixed glands were present in both groins.

Further physical examination was negative.

A diagnosis of squamous epithelioma of the penis was made.

OPERATION.—This was carried out on Feb. 12 under pentothal and open ether anæsthesia administered by J. W. R. McIntyre.

In view of the extent of the growth, radical amputation of the penis with bilateral orchidectomy was performed.

A Malecot catheter was retained per urethram to afford continuous bladder drainage.

The patient was given 2 pints of plasma during and after the operation and stood the procedure well. Penicillin (200,000 units 6-hourly) and sulphadiazine (1½ g. 6-hourly) were administered for three days after the operation. He was ambulant by the end of the first week and the wound was healed when sutures and catheter were removed on the tenth day.

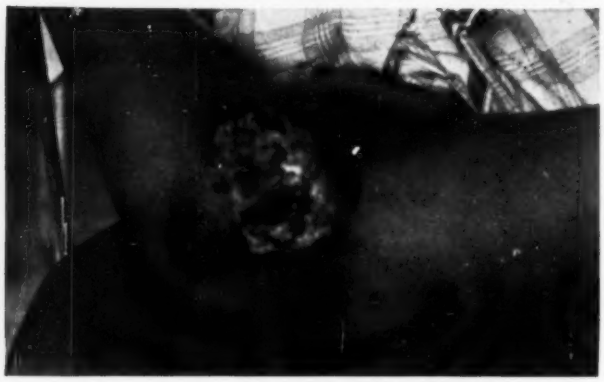

FIG. 792.—The growth as it appeared before operation.

Cystoscopy was carried out on the tenth day to ascertain the cause of the initial hæmaturia, but apart from a few thrombosed veins in the bladder wall, no abnormality was discovered. The prostate was not enlarged. Further examination under anæsthesia failed to reveal additional evidence of secondary deposits, other than the inguinal glands, which were still hard, but had decreased in size.

The patient refused bilateral block dissection of these glands as he was satisfied with the results of the initial operation and regarded himself as cured.

FOLLOW-UP EXAMINATION.—Owing to the emergency situation in Malaya, only a three months' follow-up was possible. Three months after operation, the wound was well healed and the patient was passing urine without difficulty. There was no frequency or incontinence and the stream was straight. The patient looked fit, was eating well, and gaining weight. On physical examination there was a single, soft, mobile lymph-gland in each groin. There was no other evidence of metastasis. A sound passed easily along the urethra into the bladder. *Chest radiograph* showed no secondary deposits.

The patient was examined in a follow-up by one of my colleagues during March, 1952—that is thirteen months after operation. An extract from a letter concerning the patient reads: "The man is quite alive and kicking. He complains of cough and has râles and rhonchi in all zones of both sides of his chest. The 'water works outlet' you constructed for him is working well. He has no difficulty in passing urine. His liver is not enlarged and there is no evidence of any secondaries elsewhere. A chest radiograph taken on March 5 shows only bilateral tuberculosis—no secondaries can be seen."

HISTOLOGICAL REPORT ON THE TUMOUR (A. T. H. Marsden).—The specimen shows a malignant melanoma which has ulcerated through the epithelium and infiltrated all the tissues beneath. The melanoma cells are very anaplastic and mitotic figures are numerous. (*Figs.* 793–795.)

DISCUSSION

Carson (1940) classifies malignant tumours of the penis as epithelioma, sarcoma, melanoma, endothelioma, teratoma, and secondary carcinoma or sarcoma. Most of the earlier literature regards the malignant melanoma as a sarcoma, and Joelson (1924) was able to find 35 cases of sarcoma of the penis recorded. These included fibrosarcoma, round-cell sarcoma, and 8 malignant melanomata. It is probable that the ratio of carcinoma of the penis to malignant melanoma of the penis is at least 40 to 1.

In Joelson's series, 4 sarcomata occurred in young adults (16 to 36 years), 2 in children (2 and 8 years), and 1 in an infant (10 months). None of these, however, was a melanotic growth, which is an affliction of adult life between the years of 50 and 80. The growth rate of the malignant melanoma varies considerably—in 2 of the reported cases there was an 8-year history before the patient reported for medical treatment. In other cases, lymph-node metastasis has appeared within a year of the primary growth. The case presented seems to be an example of the more rapidly growing type. Metastasis is the rule sooner or later, most commonly to the inguinal lymph-nodes and liver. Of penile sarcomata, the melanoma must be regarded as more malignant than the fibrosarcoma, but less malignant than the round-cell sarcoma.

The growth almost always begins on the glans penis, only 1 case (aged 54) being recorded as commencing on the prepuce. By contrast, fibrosarcoma and round-cell sarcoma of the penis often arises from the corpus cavernosum, and squamous epithelioma from the deep surface of the prepuce adjacent to the corona.

As a rule, the growth is not large (2–3 cm. in diameter) and may be black and ulcerated or reddish-blue and papular. Not all brown tumours are melanotic, however, for fibrosarcoma may occur as a dark brown growth. The tumour may develop on the surface of the glans or deep in its substance. The present case is unusual, both as regards its large size (9–11 cm.) and in the fact that it occurred in a member of a pigmented race in whom any type of malignant melanoma is uncommon. It has

Table I.—REPORTED CASES OF MALIGNANT MELANOMA OF THE PENIS (*After Wattenburgh*, 1944)

DIAGNOSIS	AGE	POINT OF ORIGIN	METASTASIS	DATE
Melanosarcoma	52	Glans penis	Inguinal lymph-nodes	1871
Melanotic epithelioma	75	Glans penis	None	1880
Melanosarcoma	54	Prepuce	Liver, pleura, and lymphatic glands	—
Pigmented sarcoma	—	—	—	1885
Melanosarcoma	53	Glans penis	Inguinal lymph-nodes	1887
Melanosarcoma	55	Glans penis	Liver	1896
Melanosarcoma	63	Glans penis	Inguinal lymph-nodes, liver, lungs, etc.	1899
Melanosarcoma	72	Glans penis	Inguinal lymph-nodes, and pelvis	1922
Melanotic sarcoma	48	Glans penis	None	1929
Melanotic sarcoma (2 cases)	49	Glans penis	None	1943
	78	Glans penis	Inguinal lymph-nodes	
Malignant melanoma	59	Glans penis	Lymph-nodes, liver, lungs, and adrenal	1944

been stated that in uncircumcised negroes the skin of the glans is unpigmented, but that after circumcision it becomes black like the rest of the body. It is interesting to speculate whether the present individual was uncircumcised, and therefore had an unpigmented glans, exposing him to the danger of developing malignant melanoma of the penis, which has hitherto mainly been recorded in the white races.

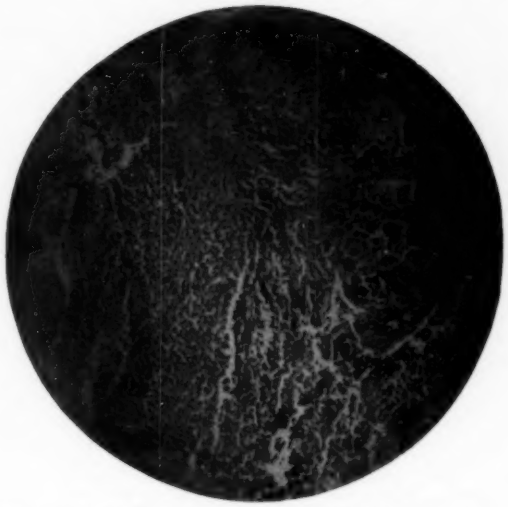

FIG. 793.—Low-power view of the malignant melanoma. Showing sheets of tumour cells. (× 120.)

Since the growth is usually small, it gives rise to relatively few symptoms, but penile or perineal pain, dysuria, deformity of the urine stream, and even acute retention have been noted. Like the one under review, Harrison's (1944) case gave a history of hæmaturia and pimples on the glans, but this was long before the actual growth developed.

Clinically, these cases are usually taken for squamous epitheliomata, and final diagnosis can only be made microscopically. Typically, microscopy shows sheets of closely packed, anaplastic cells, many of which contain amorphous masses of brown pigment in their cytoplasm. Pigment also occurs extracellularly. Mitoses are frequent and tumour giant cells may be found. On occasions, the X-ray appearance of cannon-ball lung secondaries in association with the penile growth will suggest the presence of sarcoma rather than carcinoma. Lymphopathia venereum can give rise to penile tumour, enlargement, and deformity, but can be identified by the Frei test and presence of the virus in histological sections.

Treatment is always surgical, radiation therapy being of little value. In early cases, partial amputation of the penis may be adequate, but in any case of doubt radical amputation will be necessary, with or without bilateral orchidectomy. Wheelock and Clark (1943) advise block dissection of the inguinal glands as a routine procedure. In frail patients, this can be carried out at a second operation.

The prognosis is not good, the 5-year survival rate being between 25 and 50 per cent. In Joelson's series of 35 penile sarcomata of all types, 27 lived less than six months.

SUMMARY

A case of malignant melanoma of the penis is presented. The clinical appearance, symptomatology, and prognosis are discussed.

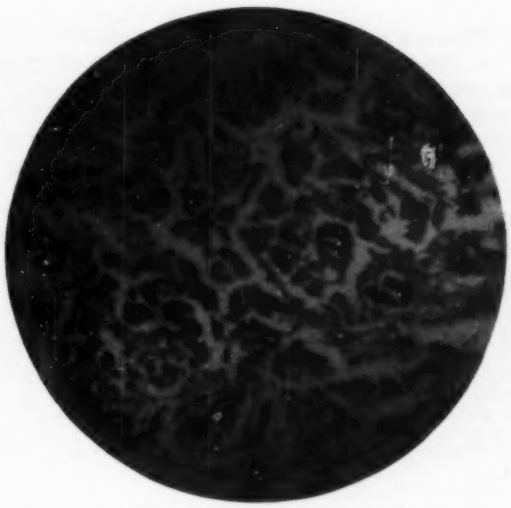

FIG. 794.—High-power view of the malignant melanoma. (× 540.)

I wish to take this opportunity of thanking Mr. F. J. Milward, Surgeon to Mansfield General Hospital, for his help in producing this article; also Dr. A. T. H. Marsden, of the Institute of Medical Research, Kuala Lumpur, for his kindness in preparing and reporting on the sections.

My thanks are also due to Brigadier Harsant, Consulting Surgeon to the British Army, for permission to publish.

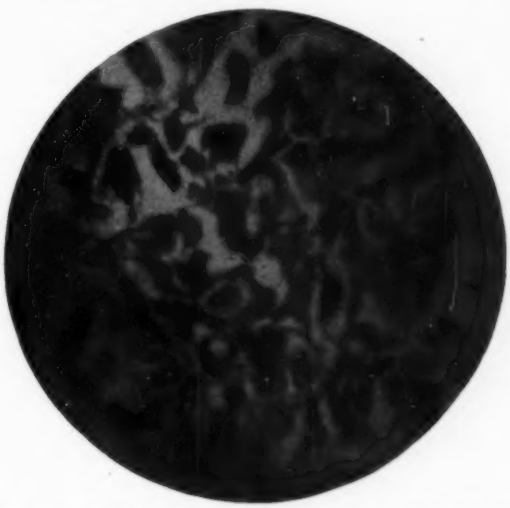

FIG. 795.—Oil-immersion view of the malignant melanoma. (× 1020.)

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TRAUMATIC CHYLOTHORAX

A REPORT OF A CASE AND A SURVEY OF THE LITERATURE

By A. B. BIRT and NEVILLE K. CONNOLLY, Norwich

Chylothorax is a rare condition, particularly when it is of traumatic origin. It is, however, a very serious complication after any accident, as it appears to carry a 50 per cent mortality. Owing to its rarity it is unusual for any one surgeon to encounter more than two or three cases during his career, and it therefore seems worth recording even a solitary case since advancement in the understanding of this condition and its treatment must come from the pooling of many individuals' experience.

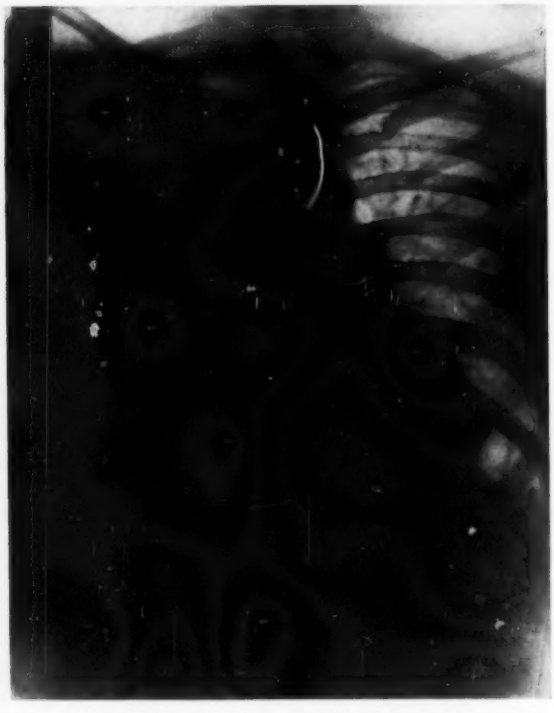

Fig. 796.—Radiograph taken on June 1, 1950, showing the presence of a very large right pleural effusion.

Shackelford and Fisher (1938) collected 41 cases of traumatic chylothorax dating back to 1695, and mentioned 11 others which were too scantily reported to be of use. Ten years later Lampson (1948) found an additional 17 cases between 1936 and 1947 and added 1 case of his own. At the discussion at the American Association of Thoracic Surgery in 1949, 6 further cases were mentioned. This increasing frequency of reports does not mean that the condition is becoming more common, but merely that it is better documented; it suggests, however, that the small total number of recorded cases gives the false impression that this condition is one of extreme rarity.

CASE REPORT

On May 28, 1950, a male (T. T.), aged 18, was seen in the Casualty Department of the Norfolk and Norwich Hospital after being involved in a motor-cycle accident. He had not suffered concussion, but could not remember exactly how he had fallen. He was complaining of pain in the right side of his chest posteriorly, and was found to be tender over the 8th, 9th, and 10th ribs on the right side posteriorly, and over the left clavicle. X-ray examination showed no evidence of bony injury and the lung fields were clear. He was considered merely to have a contusion of the chest wall and was sent home.

Four days later, June 1, he was admitted complaining of increasing dyspnœa for one day, and increasing epigastric pain for two days. At the time of admission he was noted to be a well-built, well-developed young man in good nutritional state. He was considerably dyspnœic although not cyanosed. He was somewhat shocked, with a pulse-rate of 120 per minute, blood-pressure 130/110, and his respirations were 38 per minute. His trachea was deviated to the left. The movements of the right chest were diminished and he had dullness on this side, with absence of breath-sounds and vocal fremitus. His liver was palpable 3 in. below the right costal margin. Radiography showed the presence of a large effusion into the right pleural cavity, and the mediastinum was shifted to the left (*Fig.* 796). A diagnosis of pleural effusion was made and a hæmothorax suspected. A thoracentesis was performed and two pints of brick-red, turbid fluid removed. This afforded immediate relief from the dyspnœa, and his general condition rapidly improved. Two days later, June 3, he again became dyspnœic and a further thoracentesis was performed, 4 pints being removed. The fluid at this time was still tinged pink, opaque, and clotted on standing. Further thoracenteses had to be performed on June 5, June 8, June 9, June 13, and June 17, when the following amounts were removed—2 pints, 3 pints, 2 pints, 1 pints, and 4 pints (*Fig.* 797). This fluid was shown

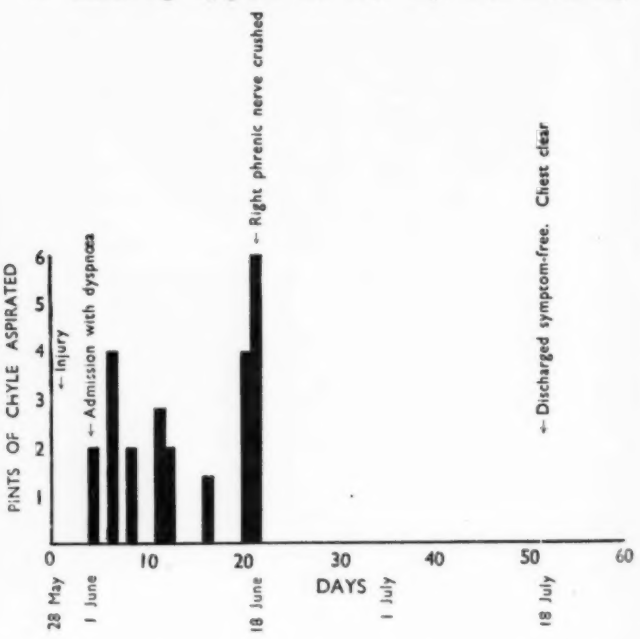

Fig. 797.—Chart to show the amounts of chyle removed from the right pleural cavity by aspiration.

to have a large amount of fat present in droplets, and had a cholesterol content of 250 mg. per cent. It was milky and was unmistakably chyle.

After the aspiration on June 17, seventeen days after admission, it was considered that more active treatment should be instituted. He had been put on a high-protein diet which, in the light of further study and thought, was probably a mistake. A rapid survey of the literature suggested that crushing the right phrenic nerve might be beneficial for reasons discussed after this case report, and it was decided to try the effect of this. By this time the patient was becoming apprehensive about himself, and consequently he was given a general anæsthetic on June 18 and his right phrenic nerve was crushed. At the same time a further thoracentesis was performed and approximately 6 pints of chyle were removed.

He was screened next day and noted to have a small amount of fluid remaining. It was decided to do nothing further until signs of dyspnœa returned. Ten days later he had developed no symptoms, and he was again screened. The diaphragm showed paradoxical movements, and there was less fluid in the chest. Chest radiography a week later, July 5, showed a high diaphragm and almost no fluid. He was discharged symptom-free on July 18, and a follow-up X-ray examination on July 24 showed the chest to be clear (*Fig.* 798). He was extremely fit and well and returned to the Navy, where he was put on light duties. He was re-examined by a Naval Surgical Specialist on Jan. 24, 1951, who courteously sent us the following report: "This rating has now no signs or symptoms which are referable to his chest injury or the subsequent chylothorax. His only complaint is of shortness of breath on exertion, and I think that this is due to the after-effects of the right phrenic crush." He was seen again on March 24, when he was working, still in the Navy, as a Sick-bay Attendant. Screening showed the chest clear and movements beginning to return in his diaphragm. He had no complaints except for a mild shortness of breath on exertion.

DISCUSSION

The reports and discussions mentioned in the introduction (Shackelford and Fisher, 1938; Lampson, 1948; and Meade, Head, and Moen, 1950) have produced conclusions as to the aetiology of the condition, but the prognosis in an individual case is unpredictable and the treatment is controversial. At the twenty-ninth Annual Meeting of the American Association for Thoracic Surgery in New Orleans, March, 1949, there appeared to be a measure of agreement as to the management of these cases, but the experience of the case reported and a further study of the literature leads us to suggest that a modification of these views may be desirable.

The aetiology has been tabulated by MacNab and Scarlett (1932), who included conditions other than traumatic which may cause chylothorax. Of the traumatic causes there are three major groups:—

1. Closed trauma: with or without fractured ribs, vertebræ, or clavicles. In these cases there appears either to have been a severe crush or hyperextension of the spine.

2. Trauma during operative procedures such as sympathectomy, thoracolysis, or removal of mediastinal tumours.

3. Penetrating wounds; gunshot or stab.

In the last two groups, the possibility of a chylous effusion into the pleural cavity is obvious, but it is much more difficult to account for it in the first group, for not only must the thoracic duct or one of its tributaries be ruptured, but the escaping chyle must then find its way from the mediastinum into the pleural cavity. A comminuted fracture of a vertebra might conceivably shear the duct, but Nowak and Barton (1941) suggest that stretching the duct over the hyperextended spine may be the important feature, and Brown (1937) considers the sharp tendinous edge of the right crus of the diaphragm to be capable of causing shearing. Brown (1937) shows in a radiograph of the case that he reports, a mass forming in the mediastinum above the diaphragm. This picture was taken between the time that the patient suffered the trauma and the development of the pleural effusion. He assumes that the duct is severed at injury, causing a collection of chyle in the posterior mediastinum, which subsequently ruptures into the pleural cavity. This accounts for the latent period between the injury and the signs of effusion which is so characteristic of the condition.

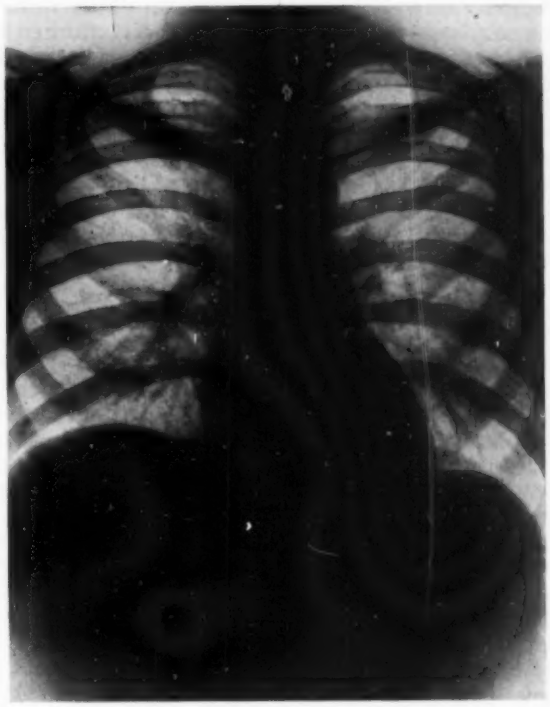

FIG. 798.—Radiograph taken on July 24, 1950, showing the chest to be practically normal again.

There is considerable variation in the severity of the cases reported and in their course and outcome. However, in studying the 39 reports of closed traumatic chylothorax tabulated by Shackelford and Fisher (1938) and Lampson (1948), some conclusions can be drawn.

There is a latent period between the time of injury and the onset of the symptoms due to chyle in the pleural cavity. The average time was just over 12 days, though it varied from 1 day in certain severe cases with multiple fractures to 9 weeks, and in the case reported by Meade and others (1950) was 3 months.

The presenting symptom is dyspnœa, unless there are other associated injuries such as fractures. The patient may be seen at the time of injury, be

treated for these associated injuries successfully, and subsequently return because of the chylothorax. If the onset is within a week or so of the injury, associated with the dyspnœa is a condition of mild shock with some tachycardia and lowering of the blood-pressure. If the latent period is long, the onset of dyspnœa may be so gradual as to present as shortness of breath on exertion.

When the patient appears with dyspnœa there are the signs of a pleural effusion which can be confirmed on X-ray examination. A thoracentesis will prove the diagnosis. Frequently the chyle at the initial aspiration will be tinged with blood, but otherwise it is a white milky fluid. This fluid is characteristic, and its nature can be confirmed by the demonstration of fat droplets, a high protein content, high cholesterol content, and the presence of a few cells (lymphocytes and eosinophils). The fluid varies with the diet, nutritional state of the patient, and the amount of pleural reaction to its presence, because it causes considerable pleural irritation. The coagulation time of chyle varies directly with its fat content, and the aspirated fluid often clots on standing. The diagnostic thoracentesis serves also to relieve the dyspnœa, and the signs of shock if they are present.

The effusion is more often into the right pleural cavity than the left (25 times in the 39 cases reviewed, 7 being bilateral, and 7 left-sided). This is associated with the fact that the trauma to the duct seems to take place most frequently a little above the diaphragm where the thoracic duct is nearer the right than the left side. All cases which could be attributed to a hypertension injury had right-sided effusions.

After the initial thoracentesis the pleural cavity tends to fill again with chyle. This rate of re-accumulation is very variable, and the factors influencing it are unknown. Daily aspirations are sometimes required, when 2 l. or more may be obtained. Frequent aspirations are the rule. In some cases rib resection has been performed to establish better drainage, but this seems quite unnecessary and to have no advantage over repeated thoracenteses. Incidentally, it is noteworthy that chyle is bacteriostatic (Lampson, 1948) and only 1 case is recorded where an empyema supervened, and that was after an open wound.

At this stage, the course seems to be either one of steadily lessening effusion leading to complete recovery, or of continued or even increased effusion leading to death from inanition due to the draining off of so much fluid, protein, and fat.

In discussing the methods of treatment, two aspects must be considered. Firstly, the general nutritional state of the patient, and secondly, measures aimed at encouraging the lesion in the thoracic duct to heal. Because an increased diet with a high fat content will increase the flow in the thoracic duct, it cannot be used to combat the depletion. As a result, intravenous therapy must be used. The returning of the aspirated chyle, by intravenous injection, since it normally flows into the jugular vein, is an obvious idea. It was first performed by Oeken (1908), and Little, Harrison, and Blalock (1942) have given as much as 22 l. without untoward effects. However, Whitcomb and Scoville (1942) reported sudden anaphylactic death after a slow infusion of a small amount of refrigerated, citrated chyle, and Peet and Campbell (1943) recorded another unexplained death, probably associated with this infusion. It would seem an invaluable method of treatment, but fresh chylous effusion should be used, it should be filtered to remove any fibrinous clots, and heparin should be added otherwise it causes extensive thromboses of the veins (Schnug and Ransohoff, 1943). It is wise to give a test dose before giving any large quantity. Plasma, saline, and glucose solutions should also be given as necessary.

The methods used to discourage the continuation of the formation of the chylous effusion must be based on the fact that some cases heal without any very active treatment, and further, that surprisingly little is known about the flow of chyle in the thoracic duct and the factors which influence it. Of the 39 cases mentioned previously, 20 have recovered, most of them with no more treatment than repeated aspirations and supportive measures. In examining these cases it is apparent that the severity of the initial injury, unless causing death itself, is not important as some of the most intractable effusions followed minor injuries. Further, the length of the latent period has no influence on the prognosis. Factors which are probably of very considerable importance are the anatomy of the thoracic duct in the particular patient, and whether the duct itself, or a tributary, is damaged. Whether the damage is a perforation or a complete tear may also be relevant. Davis (1915) found many variations in the anatomical connexions between the cisterna chyli and the venous system, and the facility with which alternate routes could be established if the main duct were ruptured or occluded would depend to some extent on these arrangements. There are persistent left-sided ducts, connexions with azygos and intercostal veins, and many alternative small ducts which could by-pass a rupture. It is, indeed, extremely difficult to cause any symptoms from ligation of the thoracic duct in dogs (Blalock and others, 1937, and Lee, 1922), and the duct has been successfully ligated in man, both at the neck and in the lower thorax (*see below*).

The flow in the thoracic duct is influenced by four factors :—

1. A *vis a tergo* effect from the amount draining into the cisterna from the lymphatics of the intestines. This force is least during starvation and maximal after a heavy meal.

2. The pressure gradient between the abdominal and thoracic cavities. During inspiration the negative pressure in the thorax serves to draw in chyle while the descending diaphragm must increase the pressure, not only on the lymphatics in the intestines, but also on the cisterna itself. Since the thoracic duct is equipped with valves, this would act as a pumping mechanism. End pressure in the thoracic duct of dogs averages about 15 cm. of water, and is raised to 35 cm. of water under forced breathing, while the resting flowing pressure is about 6·4 cm. of water (Drinker and Yoffey, 1941).

3. The autonomic nervous system. Acevedo (1943) showed that stimulation of the vagus or injection of acetylcholine caused contraction of the smooth muscle in the duct and a decrease in flow,

while adrenaline causes dilatation and an increased flow.

4. A vacuum pump effect caused by the blood in the jugular vein flowing past the open end of the thoracic duct.

Crandall, Barker, and Graham (1943) studied the flow of chyle from a thoracic duct fistula in the neck, caused by a bullet wound, before curing the patient by ligating the duct. This appears to be the only report of such a study in an otherwise healthy human. They found the rate of 'basal' flow of 0·93 c.c. per minute, or 1·38 c.c. per kilo per hour, and a maximal flow, induced by a heavy meal, of 3·9 c.c. per minute. They record that the maximal increase in flow was caused by food by mouth—fat alone doubled the flow; lesser increases followed the drinking of water and abdominal massage. Morphine and magnesium sulphate given to decrease and increase intestinal mobility had little effect. Unfortunately they do not record the effect of forced respiration, though their impression was that "the activity of skeletal muscles had little effect upon the quantity of lymph formed".

Many authors have suggested that patients with chylothorax should be placed on a high-protein, high-carbohydrate, low-fat diet with a view to maintaining the nutritional state as much as possible while minimizing the flow in the ruptured duct. It would seem more logical in the light of the foregoing facts to starve these patients and to maintain them entirely on intravenous therapy with gastric suction to immobilize the intestines. If the amount of chyle aspirated reaches serious proportions, as is so often the case, this should, with the stated precautions, be added to the intravenous therapy.

If this does not prevent re-accumulation, the right phrenic nerve should be crushed. Whether this procedure is justifiable or not is debatable, but it might have a marked effect on the second of the factors mentioned above which determine the flow in the duct. It is a minor operative procedure which can be performed under local anæsthesia, and which produces little or no permanent disability. There are three cases reported in the literature where it has been used. The first was by Nowak and Barton (1941). Their patient had a slowly re-accumulating chylothorax from whom 27·5 l. of chyle were aspirated in seventeen taps over a period of eight months. A right phrenicotomy was then performed, and therafter there was no further accumulation of fluid in the chest. Death occurred ten months after the phrenicotomy from cardiac failure. The second case was reported by Schnug and Ransohoff (1943) and was caused by a bullet severing the duct at the level of T.10 and 11. On the sixth day a chylothorax became apparent; 56·5 l. of chyle were withdrawn in thirty-three days. On the fifteenth day the right phrenic nerve was crushed with, apparently, little effect. By the thirty-second day the authors noted that the rate of chylous effusion was progressively slowing when they injected 50 c.c. of sterile broth into the pleural cavity. Thereafter there was no further re-accumulation in the chest. They regard the injection of broth and the cessation of effusion as coincidental. It is interesting to speculate whether the phrenic crush had any effect in slowing down the effusion. The third case, reported by Florer and Ochsner (1945), was a boy of 14 who suffered a blunt injury to his right chest four days before developing a right chylothorax. Over the next twenty days he required sixteen thoracenteses and 26·8 l. were aspirated. His right phrenic nerve was crushed on the tenth day, and, therafter, his rate of re-accumulation dropped according to the figures published, although this was not commented on by the authors. Prior to the phrenic crush the average rate of accumulation was 1·9 l. per day and after the crush 0·9 l. per day. He died of a perforated duodenal ulcer on the twenty-fourth day after the injury. A fourth case is reported in this article where there was either a dramatic cure by phrenic crush, or a remarkable coincidence, as the chylothorax was re-forming at an increasing rate until the time the nerve was crushed, and thereafter immediately ceased (*see Fig.* 797).

Pneumothorax has been produced artificially in several cases, but in no case has this procedure had a beneficial influence on the patient's course. This is to be expected, as it is a procedure designed to rest the lung and not the diaphragm.

If the chylothorax persists undiminished after the phrenic nerve has been crushed, ligature of the duct between the cisterna and the site of injury should be undertaken. That this is practicable and satisfactory was demonstrated by Lampson (1948), who reported the first case cured by this method. Meade and others (1950) report further successful cases, and at the discussion following Meade's paper, and reported in the *Journal of Thoracic Surgery*, other cases are mentioned, and Klepser adds a very practical hint for facilitating the finding of the duct. He has given the patient a green coal-tar dye in olive oil by duodenal tube several hours before operation. The ducts and chyle are then stained green and consequently much more easily identified.

Hodge and Bridges (1948) have suggested that the lower end of the divided duct should be anastomosed to a convenient vein. After some animal experiments they performed a successful anastomosis between the lower end of the thoracic duct and the azygos vein in a patient in whom the thoracic duct was inadvertently severed during a transthoracic thoracolumbar sympathectomy. This, however, seems to be a needlessly hazardous and difficult procedure, since simple ligation will cure the patient just as satisfactorily.

SUMMARY

A case of traumatic chylothorax which recovered after crushing the right phrenic nerve is reported.

The aetiology of traumatic chylothorax is reviewed.

The rationale of the treatment of chylothorax following closed trauma is discussed.

Three stages are proposed for this treatment:—

1. Repeated thoracenteses to relieve dyspnœa, with starvation of the patient, gastric suction, and intravenous feeding. Chyle to be given intravenously if necessary.
2. Crushing of the right phrenic nerve.
3. Ligation of the duct above the diaphragm.

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A CASE OF CONSTRICTIVE PERICARDITIS OF OVER TEN YEARS' DURATION TREATED BY PERICARDIECTOMY

BY G. GORDON CROWE, STOKE-ON-TRENT

THE indications for surgical treatment in constrictive pericarditis have been given by Tubbs (1948). They are that operation should be carried out in all cases with the following exceptions: (*a*) those patients having a long history (more than five years) and with mild symptoms which show little or no progression; and (*b*) those with evidence of active pulmonary tuberculosis. The following case report is of a case of constrictive pericarditis successfully treated by pericardiectomy although the initial symptoms of ascites and swelling of the legs had presented over ten years before operation.

CASE REPORT

The patient, L. B., a married woman of 30, was first seen by me with ascites on Dec. 11, 1950. The history was that in 1940 she had been diagnosed as a case of tabes mesenterica and referred to the T.B. Officer. She was first seen by him on Dec. 30 of that year, when she had swelling of both feet and free fluid in her abdomen. She was given sanatorium treatment from April 26, 1941, until Dec. 13, but on her discharge still had ascites and leg œdema. On Feb. 22, 1942, she had a laparotomy performed, and the cause of her ascites being deemed to be due to T.B. salpingitis she had a bilateral salpingectomy and a right oöphorectomy performed. There was no sign of tuberculosis of the intestine or mesenteric glands at operation. After this laparotomy her ascites became worse and she had to have paracentesis performed at intervals, which varied from two to four weeks, and with amounts which varied from 10 to 18 pints. Her first paracentesis was carried out in March, 1942. She was admitted to hospital at varying intervals after this during the next eight years and had innumerable paracenteses performed. In September, 1950, she was started on mersalyl by injection.

When I saw her first she was dyspnœic on exertion, orthopnœic, and became severely distressed on bending down. She was pale and had clubbing of her fingers. She had no venous congestion of her neck and her trachea was central. There was no abnormal finding in the lungs. She had a slapping precordial impulse present and some intercostal recession. The cardiac apex was in the mid-clavicular line. The second sound at the apex was prolonged and harsh. The pulse was normal and the B.P. was 120/84. The abdomen showed a severe degree of ascites and the liver was not palpable. Screening showed in the lateral view extensive calcification in the pericardium. On Jan. 9, 1951, thoracotomy was performed through the 4th left interspace anteriorly after removing the 4th and 5th costal cartilages. A constricted calcified pericardium was found, with large plaques of bony material over the left and right ventricles and over the base of the heart, and an extensive pericardiectomy was performed. The heart muscle was freed as far as the phrenic nerve on the left and as far as the auriculoventricular groove on the right. The muscle of the right ventricle was extensively infiltrated by bony plaques. The freed heart pulsated powerfully at the end of the operation. The wound was closed in layers, leaving the heart communicating with the left pleural cavity which had been entered during the operation.

The convalescence was complicated by a small loculated empyema which had to be drained under general anæsthesia on April 4. After that she recovered satisfactorily.

Pathological examination of the excised pericardium showed fibrous tissue, in parts calcified, with no cellular exudate and no evidence of tuberculosis. After the operation her ascites gradually disappeared without further paracentesis and she was discharged from hospital on June 8. Seen on July 5, as an out-patient, she was fit and well. Radiography of her chest showed no abnormality. There was no sign of ascites or œdema of the legs, she could walk long distances without becoming dyspnœic and was up and about all day and doing her own housework.

This case is published to show that in constrictive pericarditis, even if the history shows that the symptoms of ascites, etc., have been present for ten years or over, it may be worth while carrying out the operation of pericardiectomy.

My thanks are due to Dr. Charles Catlin for referring the patient to me; to Dr. Clifford Hayes for the anæsthesia; and to Dr. C. Giles for the pathological investigations.

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TWO BENIGN NEOPLASMS SUCCESSFULLY REMOVED FROM THE CENTRAL NERVOUS SYSTEM AT AN INTERVAL OF TWENTY YEARS

By G. GREY TURNER and G. F. ROWBOTHAM

MULTIPLE neoplasms of the central nervous system, other than those of von Recklinghausen's disease, have often been described. On the other hand, benign tumours appearing at intervals of time in the central nervous system is an exceedingly rare occurrence. The object of the following account is primarily to put on record such a case.

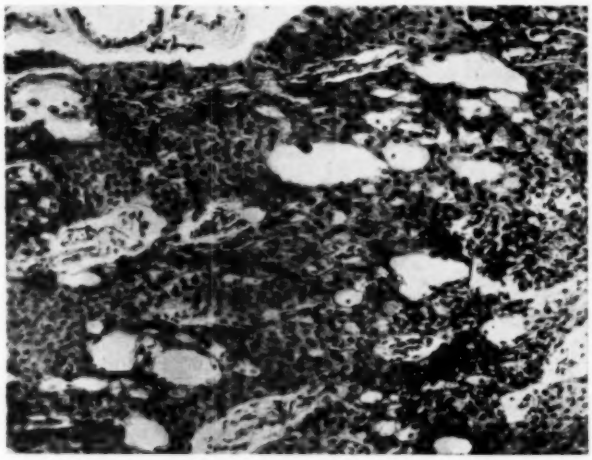

FIG. 799.—Histological section of the meningioma.

CASE REPORT

The patient, a woman of 38 years, came under the care of Professor F. J. Nattrass in the Newcastle Royal Victoria Infirmary in 1928. There was a history of subjective sensory disturbances in the left thigh for five years, impaired power in the left leg for one year, and headaches for one month.

On examination, positive findings were as follows :—

a. Bilateral papilloedema.

b. Loss of deep sensation in the joints of the left hand and foot.

c. Defective tactile discrimination in the left hand.

d. Left-sided hemiparesis.

A diagnosis was made of a right-sided parasagittal meningioma and the patient was referred to one of us (G.G.T.) for surgical treatment.

FIRST OPERATION (August, 1928—G.G.T.).—First a suitable skin-flap was turned. Then a quadrilateral of bone overlying the tumour was raised by means of linking a series of trephine holes with a chisel and mallet. On opening the dura a circumscribed tumour was seen nestling against the superior longitudinal sinus, with its deep surface buried in the brain tissue. The tumour was gently separated from the brain tissue and turned upwards over the superior longitudinal sinus, its attachment to the edge of the sinus being divided between artery forceps. To stop the bleeding the cavity of the tumour was packed with gauze, one end of which was led to the exterior. The bone-flap was replaced and the skin sutured. A few days later the gauze pack was gently removed and the wound healed by first intention.

The patient made an uninterrupted recovery from the operation and, apart from a mild hemiparesis, her neurological recovery was excellent.

The tumour removed was proved histologically to be a meningioma or dural fibroblastoma (*Fig*. 799).

The patient remained well until May, 1948, when she began to suffer from pain in the small of the back and upper part of the left buttock. The pain increased and after a few weeks became localized to the left hip region. In August of that year a further symptom developed of a burning sensation down the outer side of the left thigh.

Again she came under the care of Professor Nattrass. On examination, the positive findings were as follows :—

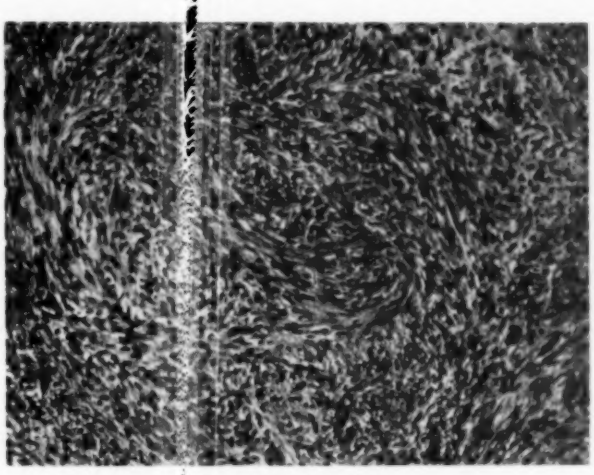

FIG. 800.—Histological section of the neuroma.

a. Mild left-sided hemiparesis (old-standing).

b. Marked restriction of spinal movements.

c. Tenderness over the left sacro-iliac joint.

Radiographs of the spine were normal. The protein content of the cerebrospinal fluid was proved to be 180 mg. per cent.

A diagnosis of a posterior root neuroma was made and the patient was transferred to the neurosurgical unit, where the diagnosis was confirmed and the level of the tumour established by a cisternal injection of lipiodol.

SECOND OPERATION (Oct. 15, 1948—G.F.R.).—Under general anæsthesia a laminectomy was carried out and a posterior root neuroma removed. (*Fig*. 800.) The operation presented no technical difficulties. The patient made a good recovery and was on her feet within 17 days.

In November, 1950, the patient reported on her present condition as follows : "I am very pleased to tell you I am very well and am able to do practically everything I did before the operation on my back."

COMMENT

According to American pathologists, meningiomata and posterior root neuromata are of very close pathogenesis, both being immature forms of fibromata and therefore named fibroblastomata. The alternative names of meningiomata and neuromata are dural fibroblastomata and perineural fibroblastomata. Both types of tumour are essentially benign, although meningioma cells tend to travel widely in the venous channels.

Finally, it is of interest to note that without the help of modern machines and tools a difficult operation on the brain can be carried out if first surgical principles are observed.

SPONTANEOUS HERNIATION THROUGH THE TRANSVERSE MESOCOLON

By R. C. B. MACRAE, Port Elizabeth

The following case merits publishing, as it adds to the literature of this rare condition and illustrates a method of closure of the hernial orifice.

CASE REPORT

The patient, Mrs. W. D. W., was first seen in September, 1948. Her age was 54. She was a neurotic, hysterical individual, who would be quite happy to talk over her worries and troubles for hours on end. Her main complaint was that she had a rupture of the abdominal wall, which had come on following an operation, and that she had abdominal pains and constipation. She also complained of unrelated pains and aches in any and every part of her body, and mention of any part of the body brought forth a stream of fresh complaints, so that no reliance could be placed on any part of her story.

Her surgical history was as follows :—

In 1941 she had had an amputation of the left breast for a tumour, which she was told was not cancerous.

In 1942, she suffered from menorrhagia, and eventually an abdominal hysterectomy was performed. Within a month after this operation she developed a rupture through the scar.

Fourteen months later, she was operated on for repair of the ventral hernia, and the abdomen was opened once more. The operation was not a success and a hernia returned immediately.

About six months later she had a further operation to the hernia, but she said that the doctor had to give it up because he found that the muscles had withered. She had then gone from doctor to doctor seeking advice, which she did not take.

On Examination.—A very large ventral hernia was found, involving the whole of a midline subumbilical scar, which was thin and much stretched out. An operation for the repair of the hernia was advised.

At Operation.—In November, 1948, the abdomen was opened under general anæsthesia, the excess loose skin was excised, the hernial sac dissected out and removed, and the abdomen opened. It was at once obvious that an unusual condition was present, as no small intestine could be seen. Passing a hand into the abdomen, a large rounded mass of small intestine was felt lying above and behind the stomach and behind the lesser omentum. Further examination revealed a hernia of practically the whole of the small intestine through an opening in the transverse mesocolon, a large sac being present, formed of the layers of the transverse mesocolon. A reference to the article by H. W. Gallagher, in the British Journal of Surgery, January, 1949, *Fig.* 433, shows the type of hernia which was present.

The orifice of the sac was immediately to the left of the middle colic artery, a large oval ring being present, stretching from the posterior abdominal wall almost to the colon. The edges of the ring were thick, tense, and strong. It proved very much easier than expected to withdraw the small intestine through the neck of the sac as no adhesions were present. The sac itself was thereafter comparatively easily pulled out from behind the stomach and it then looked like a deflated football bladder.

The problem was now to close the orifice of the hernia. The edges of the orifice were so tense that they could not be approximated in any direction. It was therefore decided to use the sac, which was a thick tough membrane, to close the opening, as it appeared strong enough permanently to close the opening and prevent a recurrence of herniation. First, the edges of the orifice were nicked all around to produce a raw surface for adhesions ; the sac was then folded over to the left side of the abdomen and carefully stitched with No. 1 catgut to the edge of the opening on the left side, from base to apex, where not already attached. The remaining portion was then folded over to the right and stitched to the edges of the ring, except where already attached, great care being taken to avoid damage to the middle colic artery. The opening was thus closed with three layers of peritoneum plus the enclosed areolar and fibrous tissue. When completed, it appeared likely that it was sufficiently strong to prevent a recurrence of herniation.

Whilst replacing the small intestine into the abdomen, a Meckel's diverticulum was found and removed. The ventral hernia was then repaired with a fascial graft, with fascia lata taken from the leg.

Progress.—The immediate result was excellent ; many of her apparently hysterical and neurotic complaints disappeared. The ventral hernia did not recur, and she was discharged from hospital, feeling better than for years.

A communication from the patient received six months later stated that she was in good health, and, as she put it, " I have got a much better figure, and the bowel is functioning wonderfully ". A year later, I heard from her again that everything was going well, and she had had no recurrence of the rupture and apparently no return of the internal hernia, as she was free from gastro-intestinal symptoms.

DISCUSSION

It is impossible to say how long the hernia had been present, but if her history of abdominal pains is accepted as being due to the hernia, it must have been present when the abdomen was first opened. The edges of the orifice and the thickness of the sac also suggest that the hernia was present for a long time. The method of repair seems worthy of consideration where a sac is present, and in this case it appears to have given a permanent and satisfactory result.

REFERENCE

Gallagher, H. W., (1949), " Spontaneous Herniation through the Transverse Mesocolon ", *Brit. J. Surg.*, **36**, 300.

REVIEWS AND NOTICES OF BOOKS

Observations on the General Effects of Injury in Man. Medical Research Council Special Report Series No. 277. By R. T. GRANT, O.B.E., F.R.C.P., F.R.S., and E. B. REEVE, B.M., M.R.C.P., from the Clinical Research Unit of the M.R.C., Guy's Hospital. H.M. Stationery Office 1951. Pp. 313. 8s. 6d.

THIS special report is extremely valuable for two reasons—it records the observations made by two experts examining in great detail 300 severely injured patients in the course of five years; and it reviews the very confusing literature on the subject of traumatic shock. If anyone seeks in this book for a straightforward definition of shock and for simple rules to enable him to diagnose it he will be disappointed. Stress is laid upon the very confused state of contemporary surgical opinion about shock, and a detailed account is given of the clinical and pathological investigations which were undertaken in this group of patients to assess the results of their injuries. A fair proportion of the patients were air-raid casualties; some were suffering from limb and abdominal injuries of civilian life; and some were Army casualties in Italy. There is no previous record which approaches this in accuracy and completeness.

The authors return over and over again to the importance of hæmorrhage as the chief cause of serious 'illness' after an injury, and they explain how the various factors such as the extent of tissue damage, the effects of pain and anxiety, various anæsthetics, and the effects of operation may influence the clinical picture right through from the time of injury till recovery or death.

It would be impossible in a short review to quote from the information given or to single out certain features for special comment so as to give the reader a true conception of the phenomenal amount of information contained in the Report or of the care which has been taken to make the observations upon patients accurate and complete. Anyone interested in the effects of trauma—and surely that must mean every surgeon—should read the Report for himself. It has been the object of the authors to set forth their own observations for the benefit of future workers in the same field, and there is no doubt that their record will be of the utmost value not only in showing how patients who have been injured are to be examined, but also how they should be treated.

Antibiotic Therapy. By HENRY WELCH, Ph.D., Director, Division of Antibiotics, Food and Drug Administration, Federal Security Agency of the United States Government; and CHARLES N. LEWIS, M.D., Medical Officer, Division of Antibiotics. 1951 The Arundel Press Inc., Washington. Pp. 562. $10.00

THIS comprehensive review of the present range of antibiotics and their uses is extremely well done. The book may be divided into two parts: the first nine chapters, which describe the properties of the antibiotics from tyrothricin to terramycin and the less well-known polymyxin, neomycin, mycomycin, viomycin, and subtilin; and the remaining eleven chapters, which start with the infections and indicate the appropriate antibiotics to be used in the treatment of each one in turn. An attractive feature is the inclusion at the beginning of every chapter of a portrait and short biographical sketch of the scientist who first introduced each antibiotic into medicine. Then follows an account of the organisms against which the substance is effective, and finally of its pharmacology, toxicity, and dosage. A full bibliography is appended to each chapter.

The work is well illustrated with graphs to show how dosage influences the concentration of the various antibiotics in the blood-stream, and reasons are clearly given not only for the use of a certain substance under given conditions of infection, but also for particular dosage and method of administration. The development of resistant strains is mentioned, particularly of staphylococci resistant to penicillin, but the problem of resistance and adaptation of organisms to antibiotic therapy is not dealt with at length. The book can be recommended with confidence as a comprehensive and reliable guide to the most effective use of the antibiotics as they are at present known.

Frontal Lobotomy and Affective Behaviour. A Neurophysiological Analysis. By JOHN F. FULTON, M.D., Sterling Professor of Physiology, Yale University. Pp. 159. 1952. London: Chapman, Hall Ltd. 21s.

THIS book is in reality Professor Fulton's Salmon Memorial Lecture and is a great contribution to our knowledge of the treatment of mental disease.

Frontal lobotomy is an operation that has come to the fore in the last decade and it is well that we should from time to time call a halt and examine our results from every angle.

Professor Fulton has added much to our knowledge of the function of the frontal lobes in monkeys and man. It is refreshing to read about the various areas in the cerebral cortex and their connexions with the central nervous system.

Various behaviour studies in animals are also seen in the human subject, and it is significant that frontal lobotomy can be used for the relief of intractable pain as well as for certain mental diseases. Lobotomy has also been suggested as a legitimate form of treatment for essential hypertension.

This book gives the best account of the results of frontal lobotomy so far recorded, and it should be read by neurologist and neurosurgeon alike.

A Synopsis of Neurology. By W. F. TISSINGTON TATLOW, M.D., M.R.C.P., J. AMOR ARDIS, M.B., Ch.B., D.P.M., and J. A. R. BICKFORD, M.R.C.S., L.R.C.P., D.P.M. $4\frac{1}{8} \times 7\frac{1}{4}$ in. Pp. 513 + xii, with 84 illustrations. 1952. Bristol: John Wright & Sons Ltd. 30s.

THIS is an addition to the well-known synopsis series published by this famous house and is written, by three Registrars, for the use of senior undergraduates and postgraduates seeking higher qualifications. Dr. A. M. G. Campbell, of Bristol, has provided a foreword in which he commends particularly the diagrams in the anatomical section, a number of which are original.

The book is made up of ten sections beginning with "Anatomy" and including, "Disorders of the Peripheral Nerves", "Cerebral Vascular Disorders", "Lesions of the Spinal Cord", and "Intracranial Tumours", and ending with, "Miscellaneous", in which the epilepsies, speech disorders, vitamin deficiency, and electro-encephalography are considered.

We should prefer to have seen the terms neurinoma and meningioma on page 393 in a list of spinal tumours rather than those given. Meningioma here appears to be used only in connexion with intracranial tumours.

The book should well serve its purpose of a manual for revision.

Tuberculosis of Bone and Joint. By G. R. GIRDLESTONE, sometime Nuffield Professor of Orthopædic Surgery in the University of Oxford, and E. W. SOMERVILLE, M.B., F.R.C.S.E., Orthopædic Surgeon to the Wingfield-Morris Orthopædic Hospital, Oxford. Second edition. Pp. 314 + xii. 1952. Oxford Medical Publications. 45s.

IT is sad to think that before this new second edition was published G. R. Girdlestone is no longer with us, but he has left us a lasting memorial in this book.

It is some twelve years since the publication of the first edition of this work and the second edition contains a large number of new illustrations and has been carefully revised.

Although new chemotherapeutic agents effective against tubercle bacillus have become available yet the well-tried standard methods of surgical treatment cannot be dispensed with until such time as a drug is found that will safely destroy all tubercle bacilli.

One can learn more about the treatment of tuberculous lesions of the skeleton in this book than in any other.

There is an excellent appendix at the end of the book which contains instructions regarding splints and appliances in common use. The plaster bandage and the bandage plaque are well described and illustrated.

This book will remain the reference volume on the subject of tuberculosis of bone and joint for many years to come.

Textbook of Surgical Treatment. Including Operative Surgery. Edited by C. F. W. ILLINGWORTH, C.B.E., M.D., Ch.M., F.R.C.S.E., F.R.F.P.S. (Glas.), Regius Professor of Surgery, University of Glasgow. Compiled by Twenty-two Contributors. Fourth edition. 6 × 9⅝ in. Pp. 744 + xii, with 381 illustrations. 1952. Edinburgh: E. & S. Livingstone Ltd. 45s.

THE new fourth edition of this well-known surgical textbook has been carefully revised and still retains its place as a very reliable guide to the management of the many and varied surgical affections.

The book is written in a lucid and easy style and only contains material which is essential for the student and practitioner to know.

A very valuable book.

Introduction to Surgery. By VIRGINA KNEELAND FRANTZ, M.D., Associate Professor of Surgery, Columbia University; and HAROLD DORTIC HARVEY, M.D., Assistant Professor of Clinical Surgery, Columbia University. Second edition. 4¾ × 7¼ in. Pp. 233 + xii, with 12 illustrations. 1951. New York: Oxford University Press. (London: Geoffrey Cumberlege.) 21s.

THIS is the second edition of this book which from the preface is evidently the text-book used at the College of Physicians and Surgeons, Columbia University, and the Presbyterian Hospital by the student who is passing through the difficult period which leads from the preclinical to the clinical course of the undergraduate curriculum.

The authors are both professors of surgery, one having a particular interest in pathology and the other in clinical surgery. It is presumed that the undergraduate has also another text-book on the same lines written by a pathologist and a physician, for as the authors say "Surgery is a branch of medicine. It is not just a technique".

The ideal text-book to help the student during this difficult period of his studies has yet to be written. This book does not fulfil the need nor will it stimulate the student to ask himself the question, Why?, which is the avowed intention of the authors.

The introduction contains seven pages devoted to a very brief and very sketchy résumé of the history of surgery. Then follows a series of sections dealing with inflammation, degenerations, atrophy, hypertrophy, repair, etc., and finally some paragraphs on deformity, cysts, and neoplasms.

The various types of injury are then considered in more detail, viz., contusions, and the various types of wounds, both superficial and deep, which involve various organs, and how repair is affected in each instance. The results of infection in various organs and cavities are then considered and again how repair is affected, usually with the help of antibiotics. The principles of treatment are also indicated. Finally the different types of hæmorrhages are described and then the approach to the patient.

The whole book resembles in many ways the modern popular literature represented by the snippets in the various readers "digests" on sale at railway bookstalls.

The book will undoubtedly appeal to some students and even teachers. To others it will raise the whole question as to how the teaching in this period should be organized. The basis should be pathology and the student should have two or more lectures each week in general pathology and bacteriology and the principles enunciated in these lectures illustrated by the approach to the patient and demonstrated by the clinical signs of disease.

Attendance at autopsy examinations conducted by the pathologist should occupy an important part of the course. At the end of such a course something has been achieved if the student has grasped the fact that a swelling may be inflammatory, cystic, or neoplastic and if the latter innocent or malignant and that a malignant neoplasm may be primary or secondary. If in addition he realizes that healing depends on blood-supply, rest, and prevention of infection and that 'the living' carries out its own repairs, then the course is worth while. The present book will probably appeal more to the inquiring student nurse than the medical student who has satisfied his examiners in anatomy and physiology.

The Essentials of Modern Surgery. Edited by R. M. HANDFIELD-JONES, M.C., M.S., F.R.C.S., Sénior Surgeon to St. Mary's Hospital; etc.; and SIR ARTHUR E. PORRITT, K.C.M.G., C.B.E., M.A., M.Ch., F.R.C.S., Surgeon to H.M. The King, Surgeon, St. Mary's Hospital; etc. Fourth edition. 6 × 9⅝ in. Pp. 1263 + xv, with 641 illustrations. 1951. Edinburgh: E. & S. Livingstone. 55s.

"No real understanding of the clinical sciences can be made without an effective integration of anatomy, physiology, pathology, and pharmacology; without their applications the clinician cannot assess nor interpret subjective symptoms which are the language of disease".—Sir George Newman.

"Twelve years have passed since the first appearance of this book (1938) at a time when Britain lay under that threat of war which was soon to become reality." This sentence introduces the preface to the fourth edition, the publication of which bears testimony to the fact that it has appealed to succeeding generations of medical students and established its place in the surgeon's library.

The greatest compliment that can be paid to the authors of what is essentially an undergraduate's textbook is that as successive editions are published they are purchased by the post-graduate to ascertain which of the so-called 'recent advances' are really worth while.

It is not such an easy thing for the authors and the editors when writing a book; it is at first a toy, then an amusement, then it becomes a mistress, then a master and finally a tyrant, and the last phase is that just as you become reconciled to the servitude, you kill the monster and strew him about to the public in a new edition.

This is all by the way to say that this, the fourth edition, has not only maintained but enhanced the standard of the previous editions. They have been reviewed in this journal in vol. xxvii, p. 189 (1939-40) and vol. xxxii, p. 333 (1944–5). What was said in general then can only be repeated now. There are fourteen different contributors and those who have 'passed on' since the last edition have been replaced by worthy successors.

There is virtually a new chapter on chemotherapy, but a word of warning is immediately stressed: "Any and all chemotherapeutic agents are but the handmaidens of good surgery; they do not replace it."

The chapter on the chest has been revised and all the conditions for the relief of which surgical procedures have been established are fully described and the operative details indicated. Those for which surgical relief is still in the experimental stage are merely mentioned as is proper in a text-book for undergraduates. The same can be said for the rest of the book.

The preliminary chapters on inflammation and repair, infection and immunity, neoplasms, wounds, burns, ulceration, gangrene, etc., have been written by the editors themselves and also of course many of the other chapters.

If the student will, from time to time, turn back to these earlier chapters he will understand the underlying pathology and appropriate treatment much better.

Thereby he will appreciate the reason why the book was ever written, as it was explained in the first edition, viz.: "to base diagnosis on clinical grounds founded on the principles of anatomy, physiology, and pathology rather than on countless laboratory investigations."

Callander's Surgical Anatomy. By BARRY J. ANSON, M.A., Ph.D. (Med. Sc.), Professor of Anatomy, Northwestern University Medical School; and WALTER G. MADDOCK, M.S., M.D., F.A.C.S., Elcock Professor of Surgery, Northwestern University Medical School. Third edition. 7 × 10 in. Pp. 1074 + xii, with 929 illustrations. 1952. Philadelphia and London: W. B. Saunders Co. 70s.

THIS well-known surgical anatomy was first published nearly twenty years ago and was popular from the first because it contained just those facts that a surgeon wanted to know. The present third edition revised by a surgeon and an anatomist is if anything more useful and practical than the two previous editions. Many new illustrations have been added and quite a number of these are original.

With the progress of modern surgery and the ever increasing specialization, every part of the body is open to operative treatment. Hence a very accurate knowledge of the mediastina, and the retropleural and the retroperitoneal tissues and organs is essential.

This book has kept abreast of surgical discovery and operative technique, and it is due to this fact that its importance lies.

The practical application of anatomy is essential to the modern surgeon and the book provides this in a very definite fashion.

Surgical Forum. Proceedings of the Forum Sessions Thirty-sixth Clinical Congress of the American College of Surgeons, Boston, Massachusetts, October, 1950. 6¼ × 9¾ in. Pp. 665 + xlviii, with 260 illustrations. 1951. Philadelphia and London: W. B. Saunders Co. 50s.

THIS remarkable volume contains well-illustrated records of short communications, usually by younger surgeons, made to the 1951 Clinical Congress of the American College of Surgeons. The papers range over the whole of surgery and are based for the most part on laboratory observations, though many are concerned with clinical research and with careful records of the results of new methods of treatment. Not all of the experimental work is entirely new, but its value lies in the novel approach, with modern instruments of precision, to old problems which were previously left unsolved, or in which there has been at least some doubt about the possibility of experimental error when using the older and more crude methods.

It would be impossible to give in this note a comprehensive review of all the papers and it would be invidious to pick out a few for special comment. Suffice it to say that the book contains much to create interest and to provoke discussion amongst any group of surgical specialists, and that it is so well produced and so fully supplied with literary references that it makes a most valuable addition to the library of every department of surgery, and indeed of every surgeon.

Portrait of a Surgeon. A Biography of John Hunter. By ERNEST A. GRAY. 5½ × 8½ in. Pp. 219 + x. Illustrated. 1952. London: Robert Hall Ltd. 16s.

THOSE of us who have read Ernest Gray's previous books are familiar with his lively and lucid style and therefore when this book appeared we knew we should get a revealing study of the surgeons' patron saint, John Hunter. There are many books on John Hunter but there is always room for another if it is informative and helps to keep alive the tradition of the great eighteenth-century surgeon and physiologist. Mr. Gray has added yet another facet to John Hunter in which he discusses the full implications of Hunter's researches upon modern biology and medicine.

This is just the book for the medical student and the busy practitioner, for each will glean useful knowledge of a great pioneer of surgical research.

Archives of the Middlesex Hospital. Vol. I. No. 1. 6¾ × 9⅝ in. Pp. 77 + iv. Edinburgh: E. & S. Livingstone Ltd. Annual subscription, £2 2s. Single number, 12s. 6d.

"*Non ignara mali, miseris succurrere disco.*"
Knowing something of misfortune myself I am learning to succour the distressed.

THE last three words of the above quotation from the *Aeneid* is the motto of the Middlesex Hospital and with the coat of arms occupies a prominent position on the cover of the resuscitated *Archives*.

The *Archives* first appeared in 1902 and the first two volumes were devoted to laboratory reports emanating from the Cancer Research Unit which was part and parcel of the Cancer Wing which was built in 1900. Later in 1905 two volumes of the *Archives* were published each year, one dealing with cancer research and the other with clinical material. They were discontinued in 1916 owing to the exigencies of the war.

The introduction of number one of the new series is written by Mr. Victor Bonney, who mentions the epoch-making papers which first appeared in the *Archives* by Sampson Handley, Archibald Leitch, William Pasteur, John Bland-Sutton, and others; he also with becoming modesty mentions his own.

The *Archives* in its new form is published quarterly and by the end of the first year no less than twenty-nine articles and also some diagnostic problems filling 291 pages of text have appeared. The wide range of subjects discussed in this volume illustrates the vast material with which the clinicians and pathologists deal every year and also the activity of the research going on in the medical school and laboratories.

It must be a great joy to the students of the Middlesex who are spread over the whole world to receive the

Archives each quarter from their Alma Mater, and both to learn and appreciate the activities of their colleagues attached to the hospital.

The Editors will find it difficult to keep to a *via media* so that the articles contributed are not too technical and deeply scientific but really useful and helpful to those who are far from libraries and medical societies. It might be well if some of the news contained in the *Middlesex Hospital Journal* is occasionally included. There is no particular reason for this, except that in these days of financial stress some may not wish to subscribe to both journals.

We welcome the appearance of this new 'local' medical journal. Its format is that which one associates with the name of the publishers. If the Editors will only keep the hospital motto in mind and thus succour the isolated and often distressed physician or surgeon there will be no difficulty in keeping it in a thriving condition and maintaining and even enhancing the standards set by its forerunner.

Pain and Its Problems. Edited by Sir HENEAGE OGILVIE, K.B.E., D.M., M.Ch., F.R.C.S., and WILLIAM A. R. THOMSON, M.D. A "Practitioner" Handbook. 5½ × 8½ in. Pp. 194. 1950. London: Eyre & Spottiswoode Ltd. (for *The Practitioner*). 12s. 6d.

THE Editor's preface begins "From time immemorial the problem of pain has vexed the minds of philosophers, theologians, and physicians". It might also be added that nowadays lawyers are also interested and can even assess pain at any rate to their own satisfaction.

It was a happy idea of the *Practitioner* to publish these essays by eighteen authors in book form; most of them have already appeared in various numbers of the journal, as a series of articles on "Pain and its Problems".

The book begins with two valuable articles reviewing the problem from the point of view of the physiologist by Professor E. D. Adrian, O.M., and from that of the neurologist by Sir Gordon Holmes. These are followed by the clinical application of the fundamental data in the previous two articles by Lord Moran, who contributes an essay on "The Meaning and Measurement of Pain".

The sensation of pain often serves a very useful function as without it a disease may reach an incurable condition. The absence of pain until the later stages in cancer of the breast is one of the main reasons why patients present themselves so late in the course of this malady.

It is a very common experience for the clinician questioning the victim and demonstrating the signs of such a case to a class of students, to be continually interrupted by the patient saying "It's never pained me", "I've had no pain whatever", etc. In fact it is of quite definite diagnostic significance whether a lump in the breast is or is not painful.

The discomfort of the patient may be such as not to be interpreted by him as a definite pain, but simply a change in function. For the first time in his life he realizes he has a stomach, a heart, or a colon. It is this change in function which should appeal to the clinician in such a way that further investigation must be made.

The measure of pain cannot be accomplished by any mathematical formula. Its estimation depends, as Lord Moran says, on the clinical experience and acumen of the practitioner. It is just in these cases that the opinion of the family doctor is such a help to the physician, surgeon, or gynæcologist.

He knows what might be described as the threshold for pain of his patient. There are people who live 'in superlatives'. Everything is marvellous or "too sweet and lovely" and to them every pain is exquisite. She may describe it as such and at the same time be putting the final touches to her 'make-up', etc. It is also an accompanying complaint that she hasn't slept a wink and heard every hour strike during the night. It is not difficult to assess the amount of such a patient's pain. The difficult patient is the one who prides himself on "not being one o' complaining sort" or doesn't wish to bother his doctor. The latter breed, according to current reports, is disappearing.

Then there is the problem of 'pain of non-organic origin'. This is skilfully and carefully epitomized by Dr. Henry Wilson in his essay. The cure is certainly not, as some aver, in prefrontal leucotomy.

The other essays or chapters are devoted to appraising the significance of pain in various clinical conditions; all are worthy of the practitioner's closest study and will be of immense help in making the diagnosis.

If there was some method of assessing pain and also endurance many clinical difficulties would be dissolved.

The great difference between organic and non-organic pain is summed up in the schoolboy's reply to his headmaster who during the course of some corporal punishment said: "You know, my boy, this hurts me more than it hurts you", to which observation the victim replied: "Yes sir! but not in the same place."

The book is so fundamental it can be strongly recommended to every clinician.

The Cancer Patient. A New Chemotherapy in Advanced Cases. By B. A. MEYER, M.B., Ch.B., L.R.C.S. & P. (Edin. & Glasg.) and I. S. ORGEL, M.D. (Dublin). 4¾ × 7½ in. Pp. 87 + viii. 1950. London: J. & A. Churchill Ltd. 7s. 6d.

THE great test of a good doctor is when he can no longer treat the disease and he has to treat the patient. In other words, when all that remains for the patient to cling to is *HOPE*. In no other disease is this so common as in treating the 'cancer patient'. The authors in the introduction to this book say "He must know what forms of treatment are available in each particular type of cancer and what hope they offer of cure and palliation . . . he must study the morale of his patient to help him in his fight against the disease; most important, he must know how to counter the dread of pain which more than any other single factor determines the outlook of the patient towards cancer".

Then they proceed in a few pages to survey the outlook of medical science on the cancer problem since recorded history, and the various theories that have been advanced to account for its occurrence.

They favour the view that the exciting cause is a virus and the specific causative factor "is a derangement of ascorbic acid due to an injured Golgi apparatus . . . the injury being due to virus, trauma, or some inherent weakness". In other words they, like all other research workers on the cancer problem, have no idea of the *actual exciting cause*.

They claim that "in cancer patients there exists a systemic deficiency of ascorbic acid while at the same time there is an excess of the material at the actual site of the lesion".

The various methods of treatment in use are epitomized: surgery, either radical or palliative; radiotherapy in combination with surgery or chemotherapy, or as the treatment of choice; and chemotherapy using either cytotoxic agents, such as nitrogen, mustard, or hormones (œstrogens).

They agree that cancer is a problem of cell growth and "Growth processes are basically alike in both plants and animals. The study of plants may easily be of importance in the cancer problem". They regard as fundamentally significant the fact that the ultimate source of the commonest experimental carcinogen, viz., benz pyridine, is from trees.

They came to the conclusion that some trees, unlike human beings, appear to have a specific defensive

mechanism against cancer. It might be said with equal certainty that some human beings have also defensive mechanism from clinical observation of the protean manifestations, differences in rate of growth, absence of metastases in some cases and rapid development in others.

They claim to have obtained from such trees a substance (a fungus metabolite) which does more than relieve the patient of pain and improves the general condition.

Their certainty of this and hence the premature publication is not enhanced by the statement " This substance has not been completely identified, nor, as yet, synthesized, but extensive laboratory tests have shewn it to be almost non-toxic ". No details of any tests are given, and, further, " It has not yet been possible to test its activity against any of the usual viruses attacking humans ".

They then consider " ascorbic acid complexes ", stating that the ascorbic acid level is raised in malignant tissue and that the Golgi apparatus in the cell is damaged, so that the apparatus cannot utilize the ascorbic acid hence there is an accumulation in the cell and at the same time a systemic deficiency.

The treatment appears to be the administration of a compound of ascorbic acid and zinc. The method of preparation, dosage, etc., is not given either of this compound or of " the fungus metabolic of the diseased tree, i.e. the cankerous tree which has resisted the canker ". These two preparations, whatever they may be, are used in the treatment of the patient by what they call " the dual approach " method.

The usual claims are made as to the effect of this treatment. They record fifteen patients, all regarded as past human aid ; eight of them died within a year. The others were still alive when the records were made, the longest survival being 21 months. They claim that pain disappeared and the general condition was improved so that they could lead more or less normal lives.

The book ends with a plea for earlier diagnosis of malignant disease based on physical examination, radiology, cytology, and blood examination, including polarography, with which all surgeons will wholeheartedly agree.

It seems a pity that all such claims as are put forward in this book should be given to the public before they have been fully endorsed by competent and independent research workers on cancer. When the " Cancer Charity " of the Middlesex Hospital was organized in 1791 by Mr. Samuel Whitebread a rule was made as follows :—

> " The Governors have rendered the cancer establishment for the trial of every new method of treatment which can with safety and propriety be adopted . . . the condition being ' Those who proposed them should previously satisfy the medical staff of their safety and within a reasonable time consent to make the treatment public '."

The book satisfies the condition of making it public but does not give the method of preparation of the substances which constitute the dual approach, nor the dose.

Techniques in British Surgery. Edited by RODNEY MAINGOT, F.R.C.S. 6¾ × 9¾ in. Pp. 733 + xx, with 473 illustrations. 1950. Philadelphia and London : W. B. Saunders Co. 75s.

As the editor states in his preface, this book is " typically British ". It consists of a series of essays written by twenty-nine leading surgeons who are all " in active practice and accomplished teachers ". They were asked " to draw mainly from their own experience and to present their subjects in their own manner with special emphasis on technique ".

One can only agree with the editor's opinion that they are " representative of the best this country can show " and right well have they followed their instructions.

The editor has chosen subjects which are still controversial and the method of technique adopted in each case is open to argument. In all the subjects considered, the young surgeon is usually not quite certain as to what is the best technique to adopt in dealing with the particular problem which presents itself in his practice. He is apt to wander from authority to authority, trying first this method and then that. This engenders a spirit of uncertainty, with the result that at the end of his training, and well into his real responsible surgical life, he develops a measure of indecision which does not add to his confidence either in himself or in any particular technique.

It is for this reason that a book such as this should prove invaluable. The method adopted by each contributor, and guided obviously by the editor, follows more or less the same plan. Each essay commences with a short historical account of what has been done in the past. This is followed by a brief description of the anatomy, physiology, and pathology of the condition for which the surgical procedure is necessary, and lastly the after-treatment and possible complications.

The detailed technique of the method which in the hands of the contributor has been found most useful is particularly emphasized. Cogent reasons are given for every step and why it is considered better than any recommended by others. The position of the patient on the table is described, which so often adds to the ease and quickness of the operation. The anæsthetic employed is stated and the reason why, and above all why other methods in this particular case are not considered so good. The days when a patient was just ' put under ' by the anæsthetist have gone. This is not said with any ulterior motive. It is evident that the method of anæsthesia has been adopted after consultation and co-operation between the surgeon and the anæsthetist. In future editions, and there must be more, the method of anæsthesia used may be changed after such consultation, so that the volume of the patient's blood is maintained and retained in the body during operative procedures, and what is left does not have to be augmented by transfusions, etc. Be that as it may! It is obvious that the anæsthetist is now recognized as an important member of the team and sees the patient before, decides on the method of anæsthesia, and deals with complications afterwards.

It would be invidious to make any subtle distinctions and comparisons between the various essays. They are all written in terse expressive language which may be due to some extent to the care of the editor who has had much experience in the past. It is not a book to be put into the hands of the undergraduate, but to those reading for the higher examinations, either in medicine, surgery, or gynæcology, which is, or should be, a branch of general surgery.

It is more and more evident that with the rapid progress of clinical pathology and the ancilliary and basic sciences, the boundary line between the basic clinical subjects is less well defined. Every physician and general surgeon should have a good idea of what the thoracic, neuro, and plastic surgeon has to offer the patient and realize that the team is strengthened by including the biochemist and biophysicist.

The general surgeon and physician who considers it is a mistake to make specialities of urology, orthopædics, and trauma and other ' side-lines ', should ponder some of these essays and realize that all wisdom and experience was not epitomized in Galen, or in the words of Ambroise Paré : " Il ne faut pas s'endirmir sur le labeur des anciens comme s'ils avaient tout su ou tout dit."

The book should be in every hospital library, but, more important, it should be in the library or bedroom of all aspiring to be a really thoughtful, competent, and up-to-date medical man.

It would be very wrong from what has been said to think that the diagnosis and treatment of the conditions

which are the subject of these essays depends merely on laboratory findings. Throughout, the emphasis is laid on the clinical aspect and the laboratory reports are definitely used as ancillary measures.

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INDEX TO VOLUME XXXIX

PAGE

ABDOMINAL wounds in jungle warfare - - 388
Abscess, periureteric, reno-inguinal fistula due to - - - - - - - - 91
— of temporal lobe, cerebral angiography in - - 156
Acrylic resin, cranioplasty with - - - - 371
Adamantinomata, pigmented - - - - 368
— of tibia - - - - - - - - - 429
Addison, Lord, as anatomist - - - - 385
Adenocarcinoma of appendix - - - - 282
— of ileum, perforation of - - - - - 71
'Adenoma', bronchial, local resection and reconstruction of left main bronchus in - - 355
— of duodenum - - - - - - - 87
— pituitary - - - - - - - - 7
Adrenaline, response of renal circulation of rabbit to 465
Age incidence of carcinoma of male breast - - 296
— — disk lesions - - - - - - - 291
— — tuberculous disease of breast - - - 420
Alkaline phosphatase in breast carcinomas - - 458
AMELI, N. O.: A practical method of vertebral angiography - - - - - - - - 327
Amputation, 'hindquarter', technique and management of - - - - - - - - - 536
ANDERSON, J. R., and WAPSHAW, H.: Annular pancreas - - - - - - - - 43
ANDREASEN, A. T., and WATSON, F.: Experimental cardiovascular surgery - - - - - 548
Aneurysm, popliteal, preserved infant's aorta in treatment of - - - - - - - 352
— saccular, of internal carotid artery in cavernous sinus - - - - - - - - 181
— of splenic artery, ruptured - - - - 469
— traumatic, of hepatic artery - - - - 278
Aneurysmorrhaphy - - - - - - - 35
Angiography, cerebral, in abscess of temporal lobe - 156
— pituitary tumours and - - - - - - 22
— vertebral, practical method of - - - - 327
Angiomas, spinal - - - - - - - - 1
Annular pancreas - - - - - - 43, 49
Aorta, infants, in treatment of popliteal aneurysm - 352
Aortic embolectomy - - - - - - - 280
— plexus, anatomical - - - - - - - 516
Appendix, adenocarcinoma of - - - - - 282
— congenital absence of - - - - - - 344
— inversion of - - - - - - - - 84
— ruptured mucocele of, diagnosis from cancer of peritoneum - - - - - - - 154
ARMITAGE, GEORGE, and RHIND, J. A.: The fate of the tumour in infantile hypertrophic pyloric stenosis - - - - - - - - - 39
Arterial aneurysm, ruptured splenic - - - 469
Arteries, large, motor innervation of - - - 333
Azygos factor in cardiovascular surgery - - 548

BACTERIAL lesions, diagnosis from cancer of peritoneum - - - - - - - - 154
BARRIE, H. J., CATES, G. W., and MCCULLOCH, E. A.: The response of the renal circulation of the rabbit to adrenaline - - - - - 465
BATTLE, R. J. V., HOVELL, J. H., and SPENCER, H.: Pigmented adamantinomata - - - - 368
BATY, JOHN A.: Abdominal wounds in jungle warfare - - - - - - - - - 388

PAGE

BATY, JOHN A.: Gastric neurilemmoma - - 251
Benign neoplasms removed from central nervous system - - - - - - - - - 569
BERKIN, C. R.: *See* FRANCE, W. G., jt. auth.
BINGOLD, A. C.: Coexistence of polyostotic fibrous dysplasia and juvenile tabes - - - - 472
BIRT, A. B., and CONNOLLY, NEVILLE K.: Traumatic chylothorax - - - - - - 564
BLACKWOOD, JAMES: Presacral perirenal pneumography - - - - - - - - - 111
Bladder, primary carcinoma of - - - - 310
BLAINE, GEORGE, and OLIVER, LESLIE C.: A simplified one-stage method of cranioplasty with acrylic resin - - - - - - - 371
Blood-vessels, renal, of rabbit, response to adrenaline 465
BLUNT, MICHAEL J.: The posterior wall of the inguinal canal - - - - - - - - 230
Bone autografts and homografts, experimental work 552
— benign chondroblastoma of - - - - - 357
Bone-bank in neurosurgery - - - - - - 31
BORRIE, PETER: Dermatofibrosarcoma protuberans 452
Breast carcinoma, alkaline phosphatase in - - 458
— — male - - - - - - - - - 296
— tuberculous disease of - - - - - - 420
BREWER, A. C., and MARCUS, R.: Mediastinal neurofibroma - - - - - - - - 382
— — *See also* MARCUS, RAPHAEL, jt. auth.
BRICKFORD, B. J., and WILLIAMSON, J. C. F. LLOYD: Annular pancreas - - - - - - - 49
Bronchial 'adenoma', local resection and reconstruction of left main bronchus in - - 355
Bronchiectasis, surgery for, results - - - 263
Bronchogenic carcinoma, phalangeal metastases in - 372
Bronchus, left main, reconstruction after local resection of 'adenoma' - - - - - 355
Buckland, Frank, and re-interment of John Hunter - 481
BUSSEY, H. J. R.: *See* GOLIGHER, J. C., jt. auth.

CÆCUM and ascending colon, acute diverticulitis of - - - - - - - - - - 76
Calcaneus, fractures of - - - - - - 395
Calcium carbonate in gall-bladder - - - 336
CALDWELL, R. A.: A case of congenital capillary hæmangioma of the parotid gland - - 261
CAMPBELL, JOHN C.: Primary carcinoma of the bladder - - - - - - - - - 310
Carcinoma (*see also* Malignant Disease; etc.)
— of bladder - - - - - - - - - 310
— breast, alkaline phosphatase in - - - 458
— — male - - - - - - - - - 296
— bronchogenic, phalangeal metastases in - - 372
— of cystic duct - - - - - - - - - 183
— developing at site of foreign bodies in lung - - 542
— of oropharynx, cervico-buccal pharyngectomy for 503
— pancreas, latent, skin metastases from - - 324
— rectum and colon, association with ulcerative colitis - - - - - - - - - 485
— — peritoneal reflection in surgery of - - 495
— — and rectosigmoid, local recurrences after sphincter-saving excisions for - - 199
— recurrent - - - - - - - - - 545
— suprarenal, sudden death caused by tumour embolus in child following operative removal of 447

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INDEX TO VOLUME XXXIX

PAGE

ABDOMINAL wounds in jungle warfare - - 388
Abscess, periureteric, reno-inguinal fistula due to - - - - - - - - 91
— of temporal lobe, cerebral angiography in - - 156
Acrylic resin, cranioplasty with - - - - 371
Adamantinomata, pigmented - - - - 368
— of tibia - - - - - - - - - 429
Addison, Lord, as anatomist - - - - 385
Adenocarcinoma of appendix - - - - 282
— of ileum, perforation of - - - - - 71
'Adenoma', bronchial, local resection and reconstruction of left main bronchus in - - 355
— of duodenum - - - - - - - 87
— pituitary - - - - - - - - 7
Adrenaline, response of renal circulation of rabbit to 465
Age incidence of carcinoma of male breast - - 296
— — disk lesions - - - - - - - 291
— — tuberculous disease of breast - - - 420
Alkaline phosphatase in breast carcinomas - - 458
AMELI, N. O.: A practical method of vertebral angiography - - - - - - - - 327
Amputation, 'hindquarter', technique and management of - - - - - - - - - 536
ANDERSON, J. R., and WAPSHAW, H.: Annular pancreas - - - - - - - - 43
ANDREASEN, A. T., and WATSON, F.: Experimental cardiovascular surgery - - - - - 548
Aneurysm, popliteal, preserved infant's aorta in treatment of - - - - - - - 352
— saccular, of internal carotid artery in cavernous sinus - - - - - - - - 181
— of splenic artery, ruptured - - - - 469
— traumatic, of hepatic artery - - - - 278
Aneurysmorrhaphy - - - - - - - 35
Angiography, cerebral, in abscess of temporal lobe - 156
— pituitary tumours and - - - - - 22
— vertebral, practical method of - - - - 327
Angiomas, spinal - - - - - - - - 1
Annular pancreas - - - - - - 43, 49
Aorta, infants, in treatment of popliteal aneurysm - 352
Aortic embolectomy - - - - - - - 280
— plexus, anatomical - - - - - - - 516
Appendix, adenocarcinoma of - - - - 282
— congenital absence of - - - - - 344
— inversion of - - - - - - - - 84
— ruptured mucocele of, diagnosis from cancer of peritoneum - - - - - - - - 154
ARMITAGE, GEORGE, and RHIND, J. A.: The fate of the tumour in infantile hypertrophic pyloric stenosis - - - - - - - - 39
Arterial aneurysm, ruptured splenic - - - 469
Arteries, large, motor innervation of - - - 333
Azygos factor in cardiovascular surgery - - 548

BACTERIAL lesions, diagnosis from cancer of peritoneum - - - - - - - - 154
BARRIE, H. J., CATES, G. W., and MCCULLOCH, E. A.: The response of the renal circulation of the rabbit to adrenaline - - - - - 465
BATTLE, R. J. V., HOVELL, J. H., and SPENCER, H.: Pigmented adamantinomata - - - 368
BATY, JOHN A.: Abdominal wounds in jungle warfare - - - - - - - - - 388

PAGE

BATY, JOHN A.: Gastric neurilemmoma - - 251
Benign neoplasms removed from central nervous system - - - - - - - - - 569
BERKIN, C. R.: *See* FRANCE, W. G., jt. auth.
BINGOLD, A. C.: Coexistence of polyostotic fibrous dysplasia and juvenile tabes - - - 472
BIRT, A. B., and CONNOLLY, NEVILLE K.: Traumatic chylothorax - - - - - - 564
BLACKWOOD, JAMES: Presacral perirenal pneumography - - - - - - - - - 111
Bladder, primary carcinoma of - - - - 310
BLAINE, GEORGE, and OLIVER, LESLIE C.: A simplified one-stage method of cranioplasty with acrylic resin - - - - - - - 371
Blood-vessels, renal, of rabbit, response to adrenaline 465
BLUNT, MICHAEL J.: The posterior wall of the inguinal canal - - - - - - - - 230
Bone autografts and homografts, experimental work 552
— benign chondroblastoma of - - - - - 357
Bone-bank in neurosurgery - - - - - - 31
BORRIE, PETER: Dermatofibrosarcoma protuberans 452
Breast carcinoma, alkaline phosphatase in - - 458
— — male - - - - - - - - - 296
— tuberculous disease of - - - - - - 420
BREWER, A. C., and MARCUS, R.: Mediastinal neurofibroma - - - - - - - - 382
— — *See also* MARCUS, RAPHAEL, jt. auth.
BRICKFORD, B. J., and WILLIAMSON, J. C. F. LLOYD: Annular pancreas - - - - - - - 49
Bronchial 'adenoma', local resection and reconstruction of left main bronchus in - - 355
Bronchiectasis, surgery for, results - - - 263
Bronchogenic carcinoma, phalangeal metastases in - 372
Bronchus, left main, reconstruction after local resection of 'adenoma' - - - - - 355
Buckland, Frank, and re-interment of John Hunter - 481
BUSSEY, H. J. R.: *See* GOLIGHER, J. C., jt. auth.

CÆCUM and ascending colon, acute diverticulitis of - - - - - - - - - - 76
Calcaneus, fractures of - - - - - - 395
Calcium carbonate in gall-bladder - - - 336
CALDWELL, R. A.: A case of congenital capillary hæmangioma of the parotid gland - - 261
CAMPBELL, JOHN C.: Primary carcinoma of the bladder - - - - - - - - - 310
Carcinoma (*see also* Malignant Disease; etc.)
— of bladder - - - - - - - - - 310
— breast, alkaline phosphatase in - - - - 458
— — male - - - - - - - - - 296
— bronchogenic, phalangeal metastases in - - 372
— of cystic duct - - - - - - - - - 183
— developing at site of foreign bodies in lung - - 542
— of oropharynx, cervico-buccal pharyngectomy for 503
— pancreas, latent, skin metastases from - - 324
— rectum and colon, association with ulcerative colitis - - - - - - - - - 485
— — peritoneal reflection in surgery of - - 495
— — and rectosigmoid, local recurrences after sphincter-saving excisions for - - 199
— recurrent - - - - - - - - - 545
— suprarenal, sudden death caused by tumour embolus in child following operative removal of 447

PAGE

Carcinoma of urethra - - - - - - - 316
Cardiovascular surgery, experimental - - - 548
Carotid artery, internal, saccular aneurysms of, in cavernous sinus - - - - - - 181
— body tumour, cervical neurofibroma in differential diagnosis of - - - - - - 454
CATCHPOLE, B. N.: Self-inflicted stripping of the rectal and colonic mucous membrane - - 464
CATES, G. W.: *See* BARRIE, H. J., jt. auth.
Cavernous sinus, saccular aneurysms of internal carotid artery in - - - - - - 181
Central nervous system, removal of benign neoplasms, with 20-year interval - - - 569
Cerebral angiography in abscess of temporal lobe - 156
Cervical neurofibroma in differential diagnosis of carotid body tumour - - - - - 454
Cervico-buccal pharyngectomy for cancer of oropharynx - - - - - - - 503
CHESTERMAN, J. T.: Results of surgery for bronchiectasis - - - - - - - 263
Cholangiography in congenital absence of gall-bladder - - - - - - - - 37
Chondroblastoma, benign, of bone - - - 357
Chondrosarcoma of ilium complicating hereditary multiple exostoses - - - - - - 73
Chylothorax, traumatic - - - - - - 564
Cicatrizing enterocolitis - - - - - - 233
CLARKE, S. H. C.: The formation of inclusion dermoid cysts following whole-thickness skin-graft repair of hernia - - - - - 346
Colitis, ulcerative, associated with benign ulcers of lesser curvature - - - - - - 303
— — association of carcinoma of rectum and colon 485
Colon, ascending, and cæcum, acute diverticulitis of 76
— obstruction by gall-stone - - - - - 339
— and rectum, carcinoma of, association with ulcerative colitis - - - - - - 485
— transverse, stomach, and jejunum, herniation into pericardium - - - - - - 364
Colonic and rectal mucous membrane, self-inflicting stripping of - - - - - - - 464
Congenital absence of gall-bladder - - - 37
— — vermiform appendix - - - - - - 344
— capillary hæmangioma of parotid gland - - 261
— sacrococcygeal teratoma - - - - - 179
CONNOLLY, NEVILLE, K.: *See* BIRT, A. B., jt. auth.
Constrictive pericarditis treated by pericardiectomy 568
Cortisone, influence of, on repair of experimental fractures in rabbit - - - - - - 172
COUNSELL, P. BRIAN, and DUKES, CUTHBERT E.: The association of chronic ulcerative colitis and carcinoma of the rectum and colon - 485
Cranioplasty with acrylic resin, simplified one-stage method - - - - - - - - - 371
CRAWSHAW, G. R.: Herniation of the stomach, transverse colon, and a portion of the jejunum into the pericardium - - - - 364
CROWE, G. GORDON: A case of constrictive pericarditis of over ten years' duration treated by pericardiectomy - - - - - - 568
— — Hæmoperitoneum due to rupture of a seminoma in an abdominal testis - - - 188
CULLEN, T. H., and MONRO, R. S.: Cervical neurofibroma in the differential diagnosis of carotid body tumour - - - - - - - - 454
CUNNINGHAM, LESLIE, HAWE, PHILIP, and EVANS, R. WINSTON: Islet-celled tumour of the pancreas with unusual clinico-pathological features - - - - - - - - - 319
Cutis grafting, epithelial survival after - - - 501
Cyst(s), dermoid, following skin-graft repair of hernia - - - - - - - - - 346
— formation in relation to stomach and œsophagus - 254
— implantation, dermoid, post-operative - - 366
— non-parasitic, of liver - - - - - - 530

PAGE

Cyst, peritoneal, due to sepsis, diagnosis from cancer 153
Cystic duct, carcinoma of - - - - - - 183
— lesion of head of pancreas - - - - - 374

D'ABREU, A. L., and MACHALE, S. J.: Bronchial 'adenoma' treated by local resection and reconstruction of the left main bronchus - 355
DALGLEISH, P. G., and TAYLOR, E. F. T.: Aortic embolectomy - - - - - - - - 280
DANIEL, OWEN: The differential diagnosis of malignant disease of the peritoneum - - 147
Death, sudden, due to tumour embolus in a child following operative removal of suprarenal carcinoma - - - - - - - - 447
Dermatofibrosarcoma protuberans - - - 452
Dermoid cysts, formation following skin-graft repair of hernia - - - - - - - - - 346
— — implantation, post-operative - - - 366
DICK, A., and KELLETT, H. S.: Reticulosarcoma of the thyroid gland - - - - - - 257
Disk operations, a study of late results from - - 289
Diverticulitis of cæcum and ascending colon - - 76
Diverticulosis of jejunum - - - - - - 139
DONIACH, I., and MCKEOWN, K. C.: A case of eosinophilic gastritis - - - - - - 247
Double gall-bladder, torsion of - - - - - 342
DOUGLAS, D. M.: *See* MUKHERJEE, S. R., jt. auth.
DRENNAN, J. M.: Alkaline phosphatase in breast carcinomas - - - - - - - - 458
DUKES, CUTHBERT E.: *See* COUNSELL P. BRIAN, jt. auth.; GOLIGHER, J. C., jt. auth.
Duodenal fistula, modified Miller-Abbott tube in - 65
Duodenum, adenoma of - - - - - - - 87
Dysplasia, multiple epiphysial - - - - - 583
— polyostotic fibrous, with juvenile tabes - - 472

EGLIN, D.: *See* GREEN, H. N., jt. auth.
ELIOTT, HAROLD, and SCOTT, H. J.: The bone-bank in neurosurgery - - - - - 31
ELTON, ARNOLD: Primary carcinoma of the male urethra - - - - - - - - - 316
ELWOOD, I. S.: *See* WIGGINS-DAVIES, W. W., jt. auth.
Embolectomy, aortic - - - - - - - - 280
Embolus, tumour, in child causing sudden death following operative removal of suprarenal carcinoma - - - - - - - - 447
Endo-aneurysmorrhaphy - - - - - - 35
Enteritis, regional, acute perforation in - - - 445
Enterocolitis, cicatrizing - - - - - - 233
Enterogenous cysts, diagnosis from cancer of peritoneum - - - - - - - - - 154
Eosinophilic gastritis - - - - - - - 247
Epiphysial dysplasia, multiple - - - - 533
Epithelial survival after cutis grafting - - - 501
— tumours of ureter - - - - - - - 313
ESSEX-LOPRESTI, PETER: The mechanism, reduction technique, and results in fractures of the os calcis - - - - - - - - - 395
Ether as gall-stone solvent - - - - - 37, 38
EVANS, R. WINSTON: *See* CUNNINGHAM, LESLIE, jt. auth.
EWING, M. R.: The significance of the level of the peritoneal reflection in the surgery of rectal cancer - - - - - - - - - 495
— — *See also* POWELL, T., jt. auth.
Exostoses, hereditary multiple, chondrosarcoma of ilium complicating - - - - - - 73
Experimental Surgery :—
Experimental cardiovascular surgery - - 548
The fate of experimental bone autografts and homografts - - - - - - - 552
The influence of cortisone on the repair of experimental fractures in the rabbit - - 172

PAGE

Experimental Surgery, *continued.*
An investigation into the value of nylon and terylene as nerve sutures - - - - - 271
The response of the renal circulation of the rabbit to adrenaline - - - - - - 465
Extrathecal hæmangiolipomas of spinal canal - - 1
Eye, displacement of globe due to head injury - - 136
EYRE-BROOK, A. L.: A study of late results from disk operations - - - - - - 281

FACIAL nerve, neurinoma of, simulating parotid tumour - - - - - - - - - 86
FARRAR, D. A. T.: Carcinoma of the cystic duct - 183
Fat necrosis, diagnosis from cancer of peritoneum - 153
— — femoral hernia simulated by - - - 277
Femoral hernia simulated by fat necrosis external to hydrocele of hernial sac - - - - 277
— region, perivascular neural pattern of - - 97
Femur, fractures of neck of - - - - - - 441
— — trochanteric - - - - - - - 166
Fibrous dysplasia, polyostotic, with juvenile tabes - 472
Fistula, duodenal, modified Miller-Abbott tube in - 65
— reno-inguinal, due to periureteric abscess - - 91
Foreign bodies in lung, carcinomata developing at site of - - - - - - - - - 542
— — peritoneal cavity, diagnosis from cancer - 153
— — swallowed, perforation of intestine by - - 349
Fracture(s), experimental, in rabbit, influence of cortisone on repair - - - - - - - 172
— of femur neck - - - - - - - - 441
— — trochanteric - - - - - - - - 166
— os calcis, mechanism, reduction technique, and results in - - - - - - - - 395
Fracture-dislocation of temporo-mandibular joint, impacted posterior - - - - - - 522
FRANCE, W. G.: Benign chondroblastoma of bone - 357
— — and BERKIN, C. R.: Trochanteric fractures of the femur - - - - - - - 166
Frank T. Paul—His life - - - - - - 195
FRATKIN, L. B., STOFFMAN, I. W., and LANDA, E.: Retroperitoneal pelvic leiomyosarcoma - 506

GALL-BLADDER, calcium carbonate in - - 336
— congenital absence of - - - - - 37
— double, torsion of - - - - - - - 342
— obstruction of colon by - - - - - - 339
Gall-stone solvents - - - - - - - 36
GARDNER, A. M. N.: The use of a modified Miller-Abbott tube in the treatment of duodenal fistula - - - - - - - - - 65
Gastric neurilemmoma - - - - - - 251
Gastritis, eosinophilic - - - - - - 247
— hypertrophic, simulating malignant disease - 233
Genitofemoral nerve, anatomy of vascular branch - 518
GIBBON, N. O. K., and LOTHIAN, K. R.: Epithelial survival after cutis grafting - - - 501
Goitre, mediastinal - - - - - - - - 120
— metastasizing - - - - - - - - - 25
— recurrent nodular, in children - - - - 433
GOLDING, J. S. R.: *See* MONRO, R. S., jt. auth.
GOLIGHER, J. C., DUKES, C. E., and BUSSEY, H. J. R.: Local recurrences after sphincter-saving excisions for carcinoma of the rectum and recto-sigmoid - - - - - - - - - 199
GORDON-TAYLOR, Sir GORDON: The John Hunter memorial service: The sermon - - - 481
— — and MONRO, ROBERT: The technique and management of the 'hindquarter' amputation - - - - - - - - - 536
GOW, I. G.: A case of reno-inguinal fistula due to periureteric abscess - - - - - - 91
— — and WALSH, ANTHONY: Acute perforation in regional enteritis - - - - - - 445

PAGE

Grafting, cutis, epithelial survival after - - - 501
GRAY, W.: *See* PATERSON, J. E., jt. auth.
GREEN, H. N., STONER, H. B., WHITELEY, H. J., and EGLIN, D.: A case of traumatic uræmia 80
GREEN, J. A. S.: Skin metastases from a latent carcinoma of the pancreas - - - - - 324
GRIME, R. T., and WHITEHEAD, RAYMOND: Giant hypertrophic gastritis simulating malignant disease - - - - - - - - - - 233

HADFIELD, G. J.: *See* SISSONS, H. A., jt. auth.
Hæmangiolipomas, extrathecal, of spinal canal 1
Hæmangioma, congenital, of parotid gland - - 261
Hæmangiomatosis of small intestine - - - 462
Hæmoperitoneum due to rupture of a seminoma in an abdominal testis - - - - - - 188
HARRIES, B. J.: *See* TAYLOR, JULIAN, jt. auth.
HAWE, PHILIP: *See* CUNNINGHAM, LESLIE, jt. auth.
Head injury, orbital complications of - - - 126
Hepatic artery, traumatic aneurysm of - - - 278
HEPTENSTALL, R. H., and PORRITT, Sir ARTHUR: Recurrent 'nodular goitre' in children - 433
Hereditary multiple exostoses, chondrosarcoma of ilium complicating - - - - - - 73
Hernia, dermoid cyst following skin-graft repair of - 346
— femoral, simulated by fat necrosis - - - 277
— inguinal, oblique proximal approach to - - 226
— — principles of surgery of - - - - 211
Hernial sac, strangulated femoral hernia simulated by fat necrosis external to hydrocele of - - 277
Herniated nucleus pulposus - - - - - 509
Herniation of stomach, transverse colon, and jejunum into pericardium - - - - 364
— through transverse mesocolon - - - - 570
HICKINBOTHAM, PAUL: Inversion of the appendix - 84
Hindquarter amputation, technique and management of - - - - - - - - 518
HINDS, J. R.: *See* MCDOWELL, C., jt. auth.
HOOPER, R. S.: Orbital complications of head injury - - - - - - - - - 126
Hormones and carcinoma of male breast - - 297
HOUGHTON, L. WYNN: Calcium carbonate in the gall-bladder - - - - - - - 336
HOVELL, J. H.: *See* BATTLE, R. J. V., jt. auth.
HUGHES, HOWELL: Adenocarcinoma of the appendix 282
Hunter (John), memorial service: The sermon - 481
Hürthle cell tumour of thyroid and skull - - 25
HUTCHISON, JOHN: The fate of experimental bone autografts and homografts - - - - 552
Hydrocele of hernial sac, femoral hernia simulated by fat necrosis external to - - - - 277
Hypertrophic gastritis simulating malignant disease 233

ILEOSTOMY, spout- - - - - - - - 309
Ileum, adenocarcinoma of, perforation of - - 71
Iliac nerve-plexuses - - - - - - - 517
Ilium, chondrosarcoma of, complicating hereditary multiple exostoses - - - - - - 73
Infantile hypertrophic pyloric stenosis, fate of tumour in - - - - - - - 39
Inguinal canal, posterior wall of - - - 230
— hernia, oblique, proximal approach to - - 226
— — principles of surgery of - - - - 211
In Memoriam:
George Grey Turner - - - - - - 193
Intervertebral disk, herniated nucleus pulposus - 509
— — operations, a study of late results from - - 289
Intestinal obstruction produced by failure of intestinal rotation - - - - - - 105
— rotation, intestinal obstruction produced by failure of - - - - - - - - 105
Intestine, perforation of by swallowed foreign bodies - - - - - - - - - 349

PAGE
Intestine, small, hæmangiomatosis of - - - 462
— vascular patterns of - - - - - - 330
Intussusception following ingestion of sewing needles 285
Irradiation of skin, pseudotuberculoid reaction following - - - - - - - - 520

JAMES, T. G. ILLTYD, and PAGEL, WALTER: Oligodendroglioma with extracranial metastases 56
— and TURNER, E. A.: Soft-tissue involvement in multiple myelomatosis - - - - - 361
Jejunum, diverticulosis of - - - - - - 139
— stomach, and transverse colon, herniation into pericardium - - - - - - - 364
Jungle warfare, abdominal wounds in - - - 388

KEITH, SIR ARTHUR: Lord Addison as anatomist 385
KELLETT, H. S.: *See* DICK, A., jt. auth.
KINMOUTH, J. B., and SIMEONE, F. A.: Motor innervation of large arteries - - - 333

LANDA, E.: *See* FRATKIN, L.B., jt. auth.
LEE, MAURICE: Recurrent carcinomata - - 545
Leiomyosarcoma of pancreas - - - - - 53
— retroperitoneal pelvic - - - - - - 506
LEWIS, C. W. D.: Strangulated femoral hernia simulated by fat necrosis external to hydrocele of hernial sac - - - - - - 277
Lipomas, spinal - - - - - - - - - 1
Liver, non-parasitic cysts of - - - - - - 530
LOGUE, VALENTINE: Saccular aneurysms of the internal carotid artery in the cavernous sinus occurring bilaterally - - - - - - 181
LOTHIAN, K. R.: *See* GIBBON, N. O. K., jt. auth.
LUMB, GEORGE: Cicatrizing enterocolitis - - 233
Lung, carcinomata developing at site of foreign bodies in - - - - - - - - - 542
— intralobar sequestration of, associated with abnormal pulmonary artery - - - 87
LYNN, R. B.: *See* MARTIN, PETER, jt. auth.

MACARTHUR, A. M.: *See* SIDDONS, A. H. M., jt. auth.
MCCULLOCH, E. A.: *See* BARRIE, H. J., jt. auth.
MCDOWELL, C., ROBB, DOUGLAS, HINDS, J. R., and NICKS, ROWAN: A case of intralobar sequestration of the lung associated with an abnormal pulmonary artery - - - - 87
MACHALE, S. T.: *See* D'ABREU, A. L., jt. auth.
MCKEOWN, K. C., and WILKINSON, K. W.: Tuberculous disease of the breast - - 420
— — *See also* DONIACK, I., jt. auth.
MACRAE, R. C. B.: Spontaneous herniation through the transverse mesocolon - - - - - 570
Male breast, carcinoma of - - - - - - 296
— urethra, primary carcinoma of - - - - 316
Malignant disease (*see also* Carcinoma; etc.)
— — of peritoneum, differential diagnosis of - 147
— — simulated by hypertrophic gastritis - - 233
— melanoma of penis - - - - - - - 561
MANGALIK, V. S., and MEHROTRA, R. M. LAL: Adamantinoma of the tibia - - - - 429
MARCUS, RAPHAEL, and BREWER, A. C.: Massive retroperitoneal teratoma - - - - - 474
— — *See also* BREWER, A. C., jt. auth.
MARTIN, PETER, and LYNN, R. B.: The use of preserved infant's aorta in the treatment of popliteal aneurysm - - - - - - - 352
Mediastinal goitre - - - - - - - - 120
— neurofibroma - - - - - - - - 382
MEHROTRA, R. M. LAL: *See* MANGALIK, V. S., jt. auth.

PAGE
Melanoma, malignant, of penis - - - - - 561
Mesocolon, transverse, herniation through - - 570
Metastases, extracranial, oligodendroglioma with - 56
— phalangeal, in bronchogenic carcinoma - - 372
Metastasizing goitre - - - - - - - - 25
Metazoan parasites, lesions due to, diagnosis from cancer of peritoneum - - - - - - 153
MIGHTON, A. K.: *See* PLEWES, BURNS, jt. auth.
MILLAR, T. MCW.: An unusual cystic lesion of the head of the pancreas - - - - - 374
Miller-Abbott tube in duodenal fistula - - - 65
MILSTEIN, B. B.: Pseudotuberculoid reaction following irradiation of the skin - - - 520
MONRO, R. S., and GOLDING, J. S. R.: Chondrosarcoma of the ilium complicating hereditary multiple exostoses - - - - - - - 73
— — *See also* CULLEN, T. H., jt. auth.; GORDON-TAYLOR, Sir GORDON, jt. auth.
Motor innervation of large arteries - - - 333
Mucocele of appendix, rupture of, diagnosis from cancer of peritoneum - - - - - 154
Mucous membrane, rectal and colonic, self-inflicting stripping of - - - - - - - - 464
MUKHERJEE, S. R., and DOUGLAS, D. M.: An investigation into the value of nylon and terylene as nerve sutures - - - - - 271
Myelomatosis, multiple, soft-tissue involvement in - 361

NEEDLES, intussusception following ingestion of 285
Neoplasms, benign, removed from central nervous system with 20-year interval - - 569
Nerve sutures, investigation into value of nylon and terylene as - - - - - - - - 271
Nerves to blood-vessels of femoral region - - 97
Neurilemmoma, gastric - - - - - - - 251
Neurinoma of facial nerve simulating parotid tumour 86
Neurofibroma, cervical, in differential diagnosis of carotid body tumour - - - - - 454
— mediastinal - - - - - - - - - 382
Neurosurgery, bone-bank in - - - - - 31
NEWNS, G. H.: Precocious sexual development due to an interstitial-cell tumour of the testis - 379
NICKS, ROWAN: *See* MCDOWELL, C., jt. auth.
'Nodular goitre', recurrent, in children - - 433
Nodules, peritoneal, due to sepsis, diagnosis from cancer - - - - - - - - - 153
NOON, CHARLES: Adenoma of the duodenum - - 87
Nucleus pulposus, herniated - - - - - 509
Nylon and terylene as nerve sutures, investigation into value of - - - - - - - - 271

ŒSOPHAGUS and stomach, cyst formation in relation to - - - - - - - - - 254
Oligodendroglioma with extracranial metastases - 56
OLIVER, LESLIE C.: *See* BLAINE, GEORGE, jt. auth.
Optic nerve changes due to head injury - - - 128
Orbital complications of head injury - - - 126
Oropharynx, cancer of, cervico-buccal pharyngectomy for - - - - - - - - 503
ORR, I. M., and RUSSELL, J. Y. W.: Diverticulosis of the jejunum—A clinical entity - - - 139
Os calcis, fractures of mechanism, reduction technique, and results - - - - - - 395
Osteoclastoma of skull - - - - - - - 527

PAGEL, WALTER: *See* JAMES, T. G. ILLTYD, jt. auth.
Pancreas, annular - - - - - - 43, 49
— cystic lesion of head of - - - - - - 374
— islet-celled tumour of, with unusual clinico-pathological features - - - - - - 319
— leiomyosarcoma of - - - - - - - 35

PAGE

Pancreas, skin metastases from a latent carcinoma of 324
Para-iliac nerve - - - - - - - - - 514
Parotid gland, congenital capillary hæmangioma of - 261
— tumour simulated by neurinoma of facial nerve - 86
PATERSON, J. E., and GRAY W.: Herniated nucleus pulposus: The free fragment - - - 509
PAUL, MILROY: A large traumatic aneurysm of the hepatic artery - - - - - - - - 278
Penis, melanoma of - - - - - - - - 561
Perforation of adenocarcinoma of ileum - - - 71
— intestine by swallowed foreign body - - - 349
— in regional enteritis - - - - - 445
Pericardiectomy for constrictive pericarditis - - 568
Pericarditis, constrictive, treated by pericardiectomy 568
Pericardium, herniation of stomach, transverse colon, and jejunum into - - - - - 364
Perirenal pneumography, presacral - - - 111
Peritoneal loose body causing acute retention - - 185
— reflection in surgery of rectal cancer - - - 495
Peritoneum, malignant disease of, differential diagnosis - - - - - - - - 147
Periureteric abscess, reno-inguinal fistula due to - 91
Perivascular neural pattern of femoral region - - 97
Phalangeal metastases in bronchogenic carcinoma - 372
Pharyngectomy, cervico-buccal, for cancer of oropharynx - - - - - - - 503
Phosphatase, alkaline, in breast carcinomas - - 458
Pigmented adamantinomata - - - - - - 368
Pituitary tumours - - - - - - - 7
PLEWES, BURNS, and MIGHTON, A. K.: Impacted posterior fracture-dislocation of the temporo-mandibular joint - - - - - - 522
Pneumatosis, diagnosis from cancer of peritoneum - 154
Pneumography, pituitary tumours and - - - 19
— presacral perirenal - - - - - - 111
Polyarteritis nodosa, diagnosis from cancer of peritoneum - - - - - - - - 154
Polyostotic fibrous dysplasia with juvenile tabes - 472
Popliteal aneurysm, preserved infant's aorta in treatment of - - - - - - - 352
PORRITT, SIR ARTHUR: *See* HEPTINSTALL, R. H., jt. auth.
Post-operative implantation dermoid cyst - - 366
POWELL, T., and EWING, M. R.: Post-operative implantation dermoid cyst - - - - 366
Precocious sexual development due to tumour of testis - - - - - - - - 379
Presacral perirenal pneumography - - - 111
Prostate, benign enlargement of - - - - 378
Pseudotuberculoid reaction following irradiation of skin - - - - - - - - - 520
Pulmonary artery, abnormal, intralobar sequestration of lung associated with - - - 87
Pyloric stenosis, infantile hypertrophic, fate of tumour in - - - - - - - 39

QUILL, D. S.: Proximal approach to oblique inguinal hernia - - - - - - - 226

RABBIT, influence of cortisone on repair of experimental fractures in - - - - 172
— response of renal circulation to adrenaline - - 465
Radiography (*see also specific forms*)
— in fractures of os calcis - - - - - 396
— pituitary adenomas and - - - - - 19
RAINS, J. H.: Congenital absence of the gall-bladder: Cholangiography: Gall-stone solvents - - - - - - - - 37
— — A contribution to the principles of the surgery of inguinal hernia - - - 211
Rare Cases:—
Adenocarcinoma of the appendix - - - 282
Adenoma of the duodenum - - - - 87

PAGE

Rare Cases, *continued.*
Aortic embolectomy - - - - - - 280
Carcinoma of the cystic duct - - - - 183
A case of congenital sacrococcygeal teratoma - 179
A case of constrictive pericarditis of over ten years' duration treated by pericardiectomy - 568
A case of intralobar sequestration of the lung associated with an abnormal pulmonary artery - - - - - - - - 87
A case of reno-inguinal fistula due to peri-ureteric abscess - - - - - - - 91
Coexistence of polyostotic fibrous dysplasia and juvenile tabes - - - - - - 472
Gross benign enlargement of the prostate - 378
Hæmoperitoneum due to rupture of a seminoma in an abdominal testis - - - - - 188
Inversion of the appendix - - - - - 84
A large traumatic aneurysm of the hepatic artery 278
Massive malignant melanoma of the penis - 561
Massive retroperitoneal teratoma - - - 474
Mediastinal neurofibroma - - - - - 383
Neurinoma of the facial nerve simulating a parotid tumour - - - - - - - 86
Peritoneal loose body causing acute retention of urine - - - - - - - - - 185
Phalangeal metastases as a first clinical sign of bronchogenic carcinoma - - - - - 372
Precocious sexual development due to an interstitial-cell tumour of the testis - - 379
Rupture of the rectum due to indirect violence - 373
Ruptured splenic arterial aneurysm - - 469
Saccular aneurysms of the internal carotid artery in the cavernous sinus occurring bilaterally - - - - - - - - - 181
Strangulated femoral hernia simulated by fat necrosis external to hydrocele of hernial sac - 277
Traumatic chylothorax - - - - - - 564
Two benign neoplasms successfully removed from central nervous system at an interval of twenty years - - - - - - - - 569
An unusual case of intussusception following ingestion of sewing needles - - - 285
An unusual cystic lesion of the head of the pancreas - - - - - - - - 374
RAVEN, RONALD W.: Combined cervico-buccal partial pharyngectomy for cancer of the oropharynx - - - - - - - 503
RECHT, W.: Torsion of a double gall-bladder - - 342
Rectal cancer, peritoneal reflection in surgery of - 495
Rectosigmoid and rectum, carcinoma of local recurrences after sphincter-saving excisions - - 199
Rectum and colon, carcinoma of, association with ulcerative colitis - - - - - - 485
— — mucous membrane of, self-inflicting stripping of - - - - - - - - - 464
— rectosigmoid, carcinoma of, local recurrences after sphincter-saving excisions - - - 199
— rupture of, due to indirect violence - - - 373
Recurrent carcinomata - - - - - - 545
Regional enteritis, acute perforation in - - - 445
REID, DOUGLAS R. K.: Acute diverticulitis of the cæcum and ascending colon - - - 76
Renal circulation of rabbit, response to adrenaline - 465
Reno-inguinal fistula due to periureteric abscess - 91
Reticulosarcoma of thyroid gland - - - - 257
Retroperitoneal pelvic leiomyosarcoma - - - 506
— teratoma - - - - - - - - - 474
Reviews (Titles):—
The abnormal pneumoencephalogram (Leo M. Davidoff and Bernard S. Epstein) - - 93
Acute head injury (Joseph P. Evans) - - 192
Amputation prosthetic service (Earle H. Daniel) - 576
Anatomy in surgery (Philip Thorek) - - 288
Antibiotic therapy (Henry Welch and Charles N. Lewis) - - - - - - - - - 571

PAGE

Reviews (Titles), *continued.*
The apologie and treatise of Ambroise Paré (ed. Geoffrey Keynes) - - - - 477
Archives of the Middlesex Hospital - - - 573
An atlas of general affections of the skeleton (Sir Thomas Fairbank) - - - - - - 383
Atlas of histological diagnosis in surgical pathology (Karl T. Neubuerger) - - - - - 384
Callander's surgical anatomy (Barry J. Anson and Walter G. Maddock) - - - - 573
The cancer patient (B. A. Meyer) - - - 574
Chest X-ray diagnosis (Max Ritvo) - - - 287
A companion to manuals of practical anatomy (E. B. Jamieson) - - - - - - 92
A complete outline of fractures (J. Grant Bonnin) 94
The diagnosis and treatment of intrathoracic new growths (Maurice Davidson) - - 479
Diseases of the heart and circulation (Paul Wood) 192
Essays in Surgery - - - - - - - 287
The essentials of modern surgery (ed. R. M. Handfield-Jones and Sir Arthur E. Porritt) - 572
Essentials of neurosurgery (Leslie C. Oliver) - 479
Fractures and joint injuries (Sir Reginald Watson-Jones) - - - - - - - 477
Frontal lobotomy and affective behaviour (John F. Fulton) - - - - - - - 571
Functional neuro-anatomy (A. R. Buchanan) - 383
A handbook of surgery (Reginald C. B. Ledlie and Michael Harmer) - - - - - 383
Indications for and results of splenectomy (Frederick A. Coller, Alexander Blain, III, and Gould Andrews) - - - - - 190
Injuries of the knee joint (I. S. Smillie) - - 479
Instruments and apparatus in orthopædic surgery (E. T. Nangle) - - - - - - - 190
Introduction to surgery (Virginia Kneeland Frantz and Harold Dortic Harvey) - - 572
Joll's diseases of the thyroid gland (Francis F. Rundle) - - - - - - - - 288
The life and times of Gaspare Togliacozzi, Surgeon of Bologna, 1545–1599 (Martha Teach Gnudi and Jerome Pierce Webster - 95
The management of fractures, dislocations, and sprains (John Albert Key and H. Earle Conwell) - - - - - - - - - 478
The mode of action of anæsthetics (T. A. B. Harris) - - - - - - - - - 287
Modern practice in tuberculosis (ed. T. Holmes Sellars and J. L. Livingstone) - - - 478
Modern surgery for nurses (ed. F. Wilson Harlow) - - - - - - - - - 94
1950 *yearbook of neurology, psychiatry and neurosurgery* (ed. Roland P. Mackay, Nolan D. C. Lewis, and Percival Bailey) - - 191
1950 *year book of orthopedics and traumatic surgery* (ed. Edward L. Compere) - - 94
The 1950 *year book of urology* (ed. William Wallace Scott) - - - - - - - 191
The 1951 *year book of general surgery* (ed. Evarts A. Graham) - - - - - - 478
The normal encephalogram (Leo M. Davidoff, and Cornelius G. Dyke) - - - - - 192
Observations on the general effects of injury in man (R. T. Grant and E. B. Reeve) - - 571
Oral and dental diseases (Herbert H. Stones) - 384
The organization of bones (P. Lacroix, trans. Stewart Gilder) - - - - - - 479
Os et tuberculose (Robert Kaufmann) - - 479
Pain and its problems (ed. Sir Heneage Ogilvie and William A. R. Thomson) - - - 574
Pedicle flaps in plastic surgery of the head and neck (Gordon B. New and John D. Erich) - 95
Physical diagnosis (Raymond W. Brust) - - 191
Plasma clot suture of peripheral nerves and nerve roots (I. M. Tarlov) - - - - - 190

PAGE

Reviews (Titles), *continued.*
Plastic surgery of the nose (James Barrett Brown and Frank McDowell) - - - - - 477
Portrait of a surgeon (Ernest A. Gray) - - 573
Post-graduate lectures on orthopedic diagnosis and indications (Arthur Steindler) - - - 478
Primary carcinoma of the liver (Charles Berman) 191
Principles and practice of surgery (Jacob K. Berman) - - - - - - - - - 92
Psychosurgery (Walter Freeman and James J. Watts) - - - - - - - - - - 286
The Radium Commission (F. G. Spear and K. Griffiths) - - - - - - - 477
Rest and pain (John Hilton, ed. E. W. Wallis and Elliot E. Philipp) - - - - - 190
Roentgen manifestations of pancreatic disease (Maxwell H. Poppel) - - - - - - 287
Royal College of Surgeons of England : A record of the years from 1901 *to* 1951 - - - 93
Royal northern operative surgery (ed. Sir Lancelot Barrington-Ward) - - - 93
Skull fractures and brain injuries (Harry E. Mock) 93
Studies in pathology (ed. E. S. J. King, T. E. Lowe, and L. B. Cox) - - - - - 96
Surgery of the stomach and duodenum (Claude E. Welch) - - - - - - - - 288
Surgical nursing and after-treatment (H. C. Rutherford Darling and T. Edward Wilson) - 191
Surgical Practice of the Lahey Clinic (various authors) - - - - - - - - - 478
Surgical technique (Stephen Power) - - 476
Surgical treatment of the motor-skeletal system (ed. Frederick W. Bancroft and Henry C. Marble) - - - - - - - - - 476
Syllabus of human neoplasms (R. M. Mulligan) - 190
A synopsis of neurology (W. F. Tissington Tatlow, J. Amor Ardis, and J. A. R. Bickford) 571
Techniques in British surgery (ed. Rodney Maingot) - - - - - - - - 575
Textbook of surgical treatment (ed. C. F. W. Illingworth) - - - - - - - 572
The thyroid (Thomas Hodge McGavack) - - 287
Tuberculosis of bone and joint (G. R. Girdlestone and E. W. Somerville) - - - - 572
Tumours of the eye (Algernon B. Reese) - - 286
Tumours of the skin (Joseph Jordan Eller and William Douglas Eller) - - - - 477
The urology of childhood (T. Twistington Higgins, D. Innes Williams, and D. F. Ellison Nash) - - - - - - - - 576
World Surgery, 1950 (Stephen A. Zieman) - 95
Wounds of the extremities in military surgery (Oscar P. Hampton, jun.) - - - - 476

Reviews (Authors) :—
Andrews, Gould : *See* Coller, Frederick A., jt. auth.
Anson, Barry J., and Maddock, Walter G. : *Callander's surgical anatomy* - - - 573
Ardis, J. Amor : *See* Tatlow, W. F. Tissington, jt. auth.
Bailey, Percival : *See* Mackay, Roland P., jt. ed.
Bancroft, Frederick W., and Marble, Henry C. : *Surgical treatment of the motor-skeletal system* (ed.) - - - - - - - - - 476
Barrington-Ward, Sir Lancelot : *Royal northern operative surgery* (ed.) - - - - - 93
Berman, Charles : *Primary carcinoma of the liver* - - - - - - - - - - 191
Berman, Jacob K. : *Principles and practice of surgery* - - - - - - - - - 92
Bickford, J. A. R. : *See* Tatlow, W. F. Tissington, jt. auth.
Blain, Alexander, III : *See* Coller, Frederick A., jt. auth.

PAGE

Reviews (Authors), *continued.*

Bonnin, J. Grant: *A complete outline of fractures* - - - - - - - - 94
Brown, James Barrett, and McDowell, Frank: *Plastic surgery of the nose* - - - - - 477
Brust, Raymond W.: *Physical diagnosis* - - 191
Buchanan, A. R.: *Functional neuro-anatomy* - 383
Coller, Frederick A., Blain, Alexander, III, and Andrews, Gould: *Indications for and results of splenectomy* - - - - - - - 190
Compere, Edward L.: 1950 *year book of orthopedics and traumatic surgery* (ed.) - - 94
Conwell, H. Earle: *See* Key, John Albert, jt. auth.
Cox, L. B.: *See* King, E. S. J., jt. ed.
Daniel, Earle H.: *Amputation prosthetic service* 576
Darling, H. C. Rutherford, and Wilson, T. Edward: *Surgical nursing and after-treatment* - - - - - - - - 191
Davidoff, Leo M., and Dyke, Cornelius G.: *The normal encephalogram* - - - - - 192
Davidoff, Leo M., and Epstein, Bernard S.: *The abnormal pneumoencephalogram* - - 93
Davidson, Maurice: *The diagnosis and treatment of intrathoracic new growth* - - - 479
Dyke, Cornelius G.: *See* Davidoff, Leo M., jt. auth.
Eller, Joseph Jordon, and Eller, William Douglas: *Tumours of the skin* - - - 477
Eller, William Douglas: *See* Eller, Joseph Jordon, jt. auth.
Epstein, Bernard S.: *See* Davidoff, Leo M., jt. auth.
Erich, John D.: *See* New, Gordon B., jt. auth.
Evans, Joseph P.: *Acute head injury* - - 192
Fairbank, Sir Thomas: *An atlas of general affections of the skeleton* - - - - 383
Frantz, Virginia Kneeland, and Harvey, Harold Dortic: *Introduction to surgery* - - - 572
Freeman, Walter, and Watts, James J.: *Psychosurgery* - - - - - - - 286
Fulton, John F.: *Frontal lobotomy and affective behaviour* - - - - - - - - 571
Gilder, Stewart: *The organization of bones* (Lacroix) (trans.) - - - - - - 479
Girdlestone, G. R., and Somerville, E. W.: *Tuberculosis of bone and joint* - - - 572
Gnudi, Martha Teach, and Webster, Jerome Pierce: *The life and times of Gaspare Tagliacozzi, surgeon of Bologna*, 1545–1599 - 95
Graham, Evarts A.: *The* 1951 *year book of general surgery* (ed.) - - - - - - 478
Grant, R. T., and Reeve, E. B.: *Observations on the general effects of injury in man* - - 571
Gray, Ernest A.: *Portrait of a surgeon* - - 573
Griffiths, K.: *See* Spear, F. G., jt. comp.
Hampton, Oscar P., jun.: *Wounds of the extremities in military surgery* - - - 476
Handfield-Jones, R. M., and Porritt, Sir Arthur E.: *The essentials of modern surgery* (ed.) - 572
Harlow, F. Wilson: *Modern surgery for nurses* (ed.) - - - - - - - - - 94
Harmer, Michael: *See* Ledlie, Reginald C. B., jt. auth.
Harris, T. A. B.: *The mode of action of anæsthetics* - - - - - - - - 287
Harvey, Harold Dortic: *See* Frantz, Virgina Kneeland, jt. auth.
Higgins, T. Twistington, Williams, D. Innes, and Nash, D. F. Ellison: *The urology of childhood* - - - - - - - - 576
Hilton, John: *Rest and pain* (ed. Walls and Philipp) - - - - - - - - 190
Illingworth, C. F. W.: *Textbook of surgical treatment* (ed.) - - - - - - - 572

PAGE

Reviews (Authors), *continued.*

Jamieson, E. B.: *A companion to manuals of practical anatomy* - - - - - - 92
Kaufmann, Robert: *Os et tuberculose* - - 479
Key, John Albert, and Conwell, H. Earle: *The management of fractures, dislocations, and sprains* - - - - - - - - - 478
Keynes, Geoffrey: *The apologie and treatise of Ambroise Paré* (ed.) - - - - - - 477
King, E. S. J., Lowe, T. E., and Cox, L. B.: *Studies in pathology* (ed.) - - - - - 96
Lacroix, P.: *The organization of bones* - - 479
Ledlie, Reginald C. B., and Harmer, Michael: *A handbook of surgery* - - - - - 383
Lewis, Charles N: *See* Welch, Henry, jt. auth.
Lewis, Nolan D. C.: *See* Mackay, Roland P., jt. ed.
Livingstone, J. L.: *See* Sellors, T. Holmes, jt. ed.
Lowe, T. E.: *See* King, E. S. J., jt. ed.
McDowell, Frank: *See* Brown, James Barrett, jt. auth. - - - - - - - - - 477
McGavack, Thomas Hodge: *The thyroid* - 287
Mackay, Roland P., Lewis, Nolan D. C., and Bailey, Percival: 1950 *year book of neurology psychiatry and neurosurgery* (ed.) - - 191
Maddock, Walter G.: *See* Anson, Barry J., jt. auth.
Maingot, Rodney: *Techniques in British surgery* (ed.) - - - - - - - - 575
Marble, Henry C.: *See* Bancroft, Frederick W., jt. ed.
Meyer, B. A.: *The cancer patient* - - - 574
Mock, Harry E.: *Skull fractures and brain injuries* - - - - - - - - 93
Mulligan, R. M.: *Syllabus of human neoplasms* 190
Nangle, E. T.: *Instruments and apparatus in orthopædic surgery* - - - - - - 190
Nash, D. F. Ellison: *See* Higgins, T. Twistington, jt. auth.
Neubeurger, Karl T.: *Atlas of histological diagnosis in surgical pathology* - - - 384
New, Gordon B., and Erich, John D.: *Pedicle flaps in plastic surgery of the head and neck* - 95
Ogilvie, Sir Heneage, and Thomson, William A. R.: *Pain and its problems* (ed.) - - 574
Oliver, Leslie C.: *Essentials of neurosurgery* - 479
Philipp, Elliot E.: *See* Walls, E. W., jt. ed.
Poppel, Maxwell H.: *Roentgen manifestations of pancreatic disease* - - - - - 287
Porritt, Sir Arthur E.: *See* Handfield-Jones, R.M., jt. ed.
Power, Stephen: *Surgical technique* - - 476
Reese, Algernon B.: *Tumours of the eye* - - 286
Reeve, E. B.: *See* Grant, R. T., jt. auth.
Ritvo, Max: *Chest X-ray diagnosis* - - 287
Rundle, Francis F.: *Joll's diseases of the thyroid gland* - - - - - - - - - 288
Scott, William Wallace: *The* 1950 *year book of urology* (ed.) - - - - - - - 191
Sellors, T. Holmes, and Livingstone, J. L.: *Modern practice in tuberculosis* (ed.) - - 478
Smillie, I. S.: *Injuries of the knee joint* - - 479
Somerville, E. W.: *See* Girdlestone, G. R., jt. auth.
Spear, F. J., and Griffiths, K.: *The Radium Commission* - - - - - - - - 477
Steindler, Arthur: *Post-graduate lectures on orthopedic diagnosis and indications* - - 478
Stones, Hubert H.: *Oral and dental diseases* - 384
Tarlov, I. M.: *Plasma clot suture of peripheral nerves and nerve roots* - - - - - 190
Tatlow, W. F. Tissington, Ardis, J. Amor, and Bickford, J. A. R.: *A synopsis of neurology* - 571

PAGE

Reviews (Authors), *continued.*
Thomson, William A. R.: *See* Ogilvie, Sir Heneage, jt. ed.
Thorek, Philip: *Anatomy in surgery* - - 288
Walls, E. W., and Philipp, Elliot E.: *Rest and pain* (ed.) - - - - - - - - - - 190
Watson-Jones, Sir Reginald: *Fractures and joint injuries* - - - - - - - 477
Watts, James J.: *See* Freeman, Walter, jt. auth.
Webster, Jerome Pierce: *See* Gnudi, Martha Teach, jt. auth.
Welch, Claude E.: *Surgery of the stomach and duodenum* - - - - - - - - - 288
Welch, Henry, and Lewis, Charles N.: *Antibiotic therapy* - - - - - - - 571
Williams, D. Innes: *See* Higgins, T. Twistington, jt. auth.
Wilson, T. Edward: *See* Darling, H. C. Rutherford, jt. auth.
Wood, Paul: *Diseases of the heart and circulation* - - - - - - - - - - 192
Zieman, Stephen A.: *World Surgery*, 1950 - 95
Rhabdomyosarcoma of thigh - - - - - 524
RHIND, J. A.: *See* ARMITAGE, GEORGE, jt. auth.
RICKHAM, P. P.: A case of hæmangiomatosis of the small intestine - - - - - - - - 462
ROBB, DOUGLAS: *See* MCDOWELL, C., jt. auth.
ROBERTS, D. I.: Massive malignant melanoma of the penis - - - - - - - - - 561
ROBERTS, KEITH D.: A case of congenital sacro-coccygeal teratoma - - - - - - - 179
ROBINSON, J. O.: Congenital absence of vermiform appendix - - - - - - - - 344
ROGERS, LAMBERT: Endo-aneurysmorrhaphy - 35
ROSS, C. F.: Leiomyosarcoma of the pancreas - 53
ROSS, JAMES A.: Vascular patterns of small and large intestine compared - - - - - 330
ROWBOTHAM, G. F.: An osteoclastoma of the skull 527
— — *See also* TURNER, G. GREY, jt. auth.
Rupture of abdominal testicular seminoma, hæmo-peritoneum due to - - - - - - 188
— rectum due to indirect violence - - - 373
Ruptured splenic arterial aneurysm - - - 469
RUSSELL, J. Y. W.: *See* ORR, I. M., jt. auth.

SACCULAR aneurysms of internal carotid artery in cavernous sinus - - - - - - 181
Sacrococcygeal teratoma, congenital - - - 179
SCHURR, P. H.: Cerebral angiography in abscess of the temporal lobe - - - - - - 156
— — *See also* TAYLOR, JULIAN, jt. auth.
SCOTT, H. J.: *See* ELLIOTT, HAROLD, jt. auth.
Seminoma, hæmoperitoneum due to rupture of, in an abdominal testis - - - - - - 188
Sequestration, intralobar, of lung associated with abnormal pulmonary artery - - - - 87
Sex incidence in diverticulosis of jejunum - - 139
Sexual development, precocious, due to tumour of testis - - - - - - - - - 379
SHAW, R. CUNLIFFE: Cyst formation in relation to the stomach and œsophagus - - - - 254
— — Metastasizing goitre - - - - - 25
SHEPHERD, JOHN A.: Peritoneal loose body causing acute retention of urine - - - - - 185
SIDDONS, A. H. M., and MACARTHUR, A. M.: Carcinomata developing at the site of foreign bodies in the lung - - - - - - - 542
SIMEONE, F. A.: *See* KINMOUTH, J. B., jt. auth.
SISSONS, H. A., and HADFIELD, G. J.: The influence of cortisone on the repair of experimental fractures in the rabbit - - - - - 172
Skin metastases from latent carcinoma of pancreas - 324
— pseudotuberculoid reaction following irradiation of - - - - - - - - - - 520

PAGE

Skin-graft repair of hernia, dermoid cyst following - 346
Skull, Hürthle cell tumour of - - - - - 25
— osteoclastoma of - - - - - - - 527
Soft-tissue involvement in multiple myelomatosis - 361
SOMERVILLE, PHILIP: Carcinoma of the male breast 296
— — A case of rhabdomyosarcoma of the thigh - 524
— — Perforation of adenocarcinoma of ileum - 71
SPENCER, H.: *See* BATTLE, R. J. V., jt. auth.
SPENCER, R.: Intestinal obstruction produced by failure of intestinal rotation - - - - 105
— — An unusual case of intussusception following ingestion of sewing needles - - - 285
Sphincter-saving excisions for carcinoma of rectum and rectosigmoid, local recurrences after - 199
Spinal canal, extrathecal hæmangiolipomas of - 1
Splenic arterial aneurysm, ruptured - - - 469
Splenosis, diagnosis from cancer of peritoneum - 154
Spontaneous herniation through the transverse mesocolon - - - - - - - - 570
Spout ileostomy - - - - - - - - - 309
STOCK, FRANCIS E.: Non-parasitic cysts of the liver 530
STOFFMAN, I. W.: *See* FRATKIN, L.B., jt. auth.
Stomach, greater curvature of, benign ulcers of - 303
— and œsophagus, cyst formation in relation to - 254
— transverse colon, and jejunum, herniation into pericardium - - - - - - - - 364
STONER, H. B.: *See* GREEN, H. N., jt. auth.
STRONG, ROBERT: Phalangeal metastases as a first clinical sign of bronchogenic carcinoma - 372
Strangulated femoral hernia simulated by fat necrosis external to hydrocele of hernial sac - 277
Subtaloid joint, fractures involving - - - 396
Suprarenal carcinoma, sudden death caused by tumour embolus in child following operative removal of - - - - - - - - 447
Surgical Forum (36 Clin. Congr. Amer. Coll. Surg.) 573
Sutures, nerve, investigation into value of nylon and terylene as - - - - - - - 271

TABES, juvenile, with polyostotic fibrous dysplasia - - - - - - - - - 472
TAGART, R. E. B.: Ruptured splenic arterial aneurysm - - - - - - - - 469
TAYLOR, E. E. T.: *See* DALGLEISH, P. G., jt. auth.
TAYLOR, JULIAN, HARRIES, B. J., and SCHURR, P. H.: Extrathecal hæmangiolipomas of the spinal canal - - - - - - - - - 1
Temporal lobe abscess, cerebral angiography in - 156
Temporomandibular joint, fracture-dislocation of - 522
Teratoma, massive retroperitoneal - - - 474
— sacrococcygeal congenital - - - - 179
Terylene and nylon as nerve sutures, investigation into value of - - - - - - - - 271
Testis, abdominal, hæmoperitoneum due to rupture of a seminoma in - - - - - - 188
— tumour of, precocious sexual development due to 379
Thigh, rhabdomyosarcoma of - - - - 524
Thyroid gland, metastasizing goitre in - - - 25
— — reticulosarcoma of - - - - - 257
Tibia, adamantinoma of - - - - - 429
TODD, R. MCLAREN: Sudden death caused by tumour embolus in a child of four years following operative removal of suprarenal carcinoma - - - - - - - 447
Torsion of double gall-bladder - - - - 342
Trauma in aetiology of cancer of breast - - 297
Traumatic aneurysm of hepatic artery - - - 278
— chylothorax - - - - - - - - 564
— uræmia, a case of - - - - - - - 80
Trochanteric fractures of femur - - - - 166
Trueta shunt, experimental investigation - - 465
TRUMBLE, HUGH C.: Pituitary tumours - - 7
Tuberculous disease of breast - - - - 420
— peritonitis, diagnosis from cancer - - - 152

PAGE

Tumour embolus in child causing sudden death following operative removal of suprarenal carcinoma - - - - - - - - 447
— the fate of, in infantile hypertrophic pyloric stenosis - - - - - - - - - 39
— pituitary - - - - - - - - - 7
TURNER, E. A.: *See* JAMES, T. G. I., jt. auth.
TURNER, G. GREY, and ROWBOTHAM, G. F.: Two benign neoplasms successfully removed from the central nervous system at an interval of twenty years - - - - - - - - 569

ULCERATIVE colitis associated with benign ulcers of lesser curvature - - - - - 303
— — — — carcinoma of rectum and colon - 485
Ulcers, benign, of greater curvature - - - 303
Uræmia, traumatic, a case of - - - - - 80
Ureter, primary epithelial tumours of - - - 313
Urethra, male, primary carcinoma of - - - 316
Urine, retention of, peritoneal loose body causing - 185

VASCULAR patterns of small and large intestine compared - - - - - - - - - 330
Vertebral angiography, practical method of - - 327
Vision, changes complicating head injury - 126, 133

WADE, J. S. H.: Neurinoma of the facial nerve simulating a parotid tumour - - - 86

PAGE

WALLEY, JON: Some observations on fractures of the neck of the femur - - - - - - 441
WALSH, ANTHONY: *See* GOW, J. G., jt. auth.
WAPSHAW, H.: *See* ANDERSON, J. R., jt. auth.
WARD, MCQUAID, J. N.: Perforation of the intestine by swallowed foreign bodies - - - 349
Warfare, jungle, abdominal wounds in - - - 388
WATSON, F.: *See* ANDREASEN, A. T., jt. auth.
WATT, J. KENNEDY: Multiple epiphysial dysplasia - 533
WELBOURN, RICHARD B.: Benign ulcers of the greater curvature - - - - - - - 303
WELLS, CHARLES A.: A skin-covered spout ileostomy - - - - - - - - - 309
WHITEHEAD, RAYMOND: *See* GRIME, R. T., jt. auth.
WHITELEY, H. J.: *See* GREEN, H. N., jt. auth.
WIGGINS-DAVIES, W. W., and ELWOOD, J. S. Primary epithelial tumours of the ureter - 313
WILDE, F. ROLAND: The para-iliac nerve - - 514
— — The perivascular neural pattern of the femoral region - - - - - - - 97
WILKINSON, K. W.: *See* MCKEOWN, K. C., jt. auth.
WILLIAMSON, J. C. F. LLOYD: Obstruction of colon by gall-stone - - - - - - - - 339
— — *See also* BICKFORD, B. J., jt. auth.
WILLSON-PEPPER, J. K.: Gross benign enlargement of the prostate - - - - - - - 330
WILSON, EDRIC: Mediastinal goitre - - - 120
WINDSOR, HARRY M.: Rupture of the rectum due to indirect violence - - - - - 373
Wounds, abdominal, in jungle warfare - - - 388

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